

Sixth Generation Computers

Dr. Dobb's Journal

For the Experienced in Microcomputing

#91 MAY 1984

\$2.95 [3.50 Canada]

*A New
Library
for
Small*

**Introduction
to Modula 2**

**Converting
Fig-Forth
to Forth-83**



05

Self-dFENSETM for EDP managers.

The micro invasion has begun. And, chances are, you've now got a lot of different people in a lot of different departments using a lot of different micros.

Now there's a way for you to control and maximize the benefits of all the different micros in your domain.

Fight back with dBASE II.[®]

dBASE II is the relational database management system from Ashton-Tate that enables you to manage your micro-based corporate data resources with the high level of consistency and sophistication you've enjoyed with mainframe and minicomputer systems.

Armed with dBASE II and the dBASE II RunTime[™] program development module, you can write programs which will enable micro users in each department to "do their own thing" while creating complete database consistency throughout the company.

dBASE II is a powerful, flexible way for you to effectively manage the micro proliferation.



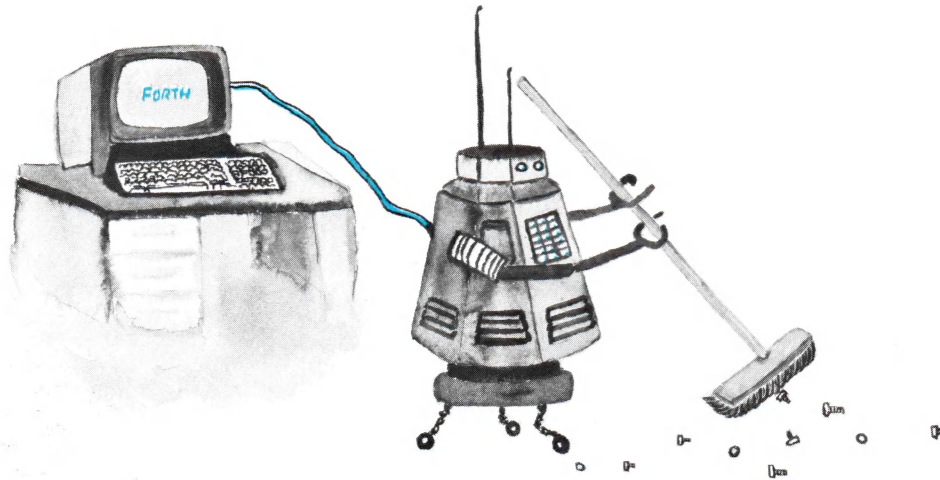
Help is here.

If you'd like to know more about how dBASE II and RunTime can help you win the micro management battle, contact Ashton-Tate today. 10150 West Jefferson Boulevard, Culver City, CA 90230. (800) 437-4329, ext. 217. In Colorado (303) 799-4900. In the U.K. (0908) 568866.

ASHTON · TATE  TM

dBASE II is a registered trademark and RunTime is a trademark of Ashton-Tate.
Suggested retail price for dBASE II is \$700.
© Ashton-Tate 1984

FORTH GIVES YOU TOTAL CONTROL



GRAPHICS • GAMES • COMMUNICATIONS ROBOTICS • DATA ACQUISITION • PROCESS CONTROL

FORTH: for Z-80®, 8080, 8086, 68000, and IBM® PC
(Complies with the New 83-Standard)

- **FORTH** programs are instantly portable across the four most popular microprocessors.

- **FORTH** is interactive and 20 times faster than BASIC.

- **FORTH** programs are highly structured and easy to maintain.

- **FORTH** provides direct control over all interrupts, memory locations, and i/o ports.

- **FORTH** allows full access to DOS files and functions.

- **FORTH** application programs can be distributed as turnkey COM files with no license fee.

- **FORTH** Cross Compilers are available for ROM'ed or disk based applications on most microprocessors.

- Custom programming, consulting, and educational services available.

FORTH Application Development Systems include interpreter/compiler with virtual memory management and multi-tasking, assembler, full screen editor, de-compiler, utilities, and detailed technical manual. Standard random access files used for screen storage, extensions provided for access to all operating system functions.

Z-80 FORTH for CP/M® 2.2 or MP/M II, \$50.00; **8080 FORTH** for CP/M 2.2 or MP/M II, \$50.00; **8086 FORTH** for CP/M-86 or MS-DOS, \$100.00; **PC/FORTH™** for PC-DOS, CP/M-86, or CCPM, \$100.00; **68000 FORTH** for CP/M-68K, \$250.00

FORTH + Systems are 32 bit implementations that allow creation of programs as large as 1 megabyte. The entire memory address space of the 68000 or 8086/88 is supported directly for programs and data.

PC FORTH + \$250.00
8086 FORTH + for CP/M-86 \$250.00
68000 FORTH + for CP/M-68K \$400.00

FORTH Cross Compiler allows you to customize the FORTH nucleus, recompile on a host computer for a different target computer, generate headerless and ROM-able code. Supports forward referencing. Produces executable image in RAM or disk file. No license fee for applications, \$300.00.

FORTH Native Code Compilers

For Z80 FORTH and CP/M \$100.00
For 8086 FORTH and CP/M-86 \$200.00
For IBM PC and PC-DOS \$200.00

Extension Packages

Software floating point (Z-80, 8086, PC only), \$100.00; AMD 9511 support (Z-80, 8086, 68000 only), \$100.00; Intel 8087 support (8086, PC only), \$100.00; Advanced color graphics (PC only), \$100.00; Symbolic interactive debugger (PC only), \$100.00; PC/TERM Communications/file transfer for Smartmodem, \$60.00; Cross reference utility, \$25.00; PC/GEN (custom character sets, PC only), \$50.00; Curry FORTH Programming Aids, \$150.00; B-Tree index manager, \$125.00; B-Tree index and file manager, \$200.00; QTF + Screen editor for IBM PC, \$100.00; Quad Integer Math Pack, \$25.00.

AUGUSTA, Ada subset compiler from Computer Linguistics for Z-80 CP/M 2.2 systems, \$90.00

"Starting FORTH" tutorial by Brodie, soft-cover, \$16.00.

INTEL 8087-3 Numeric Coprocessor, \$250.00

Z-80 and 8080 **FORTH** require 48 Kbytes RAM. 8086 and 68000 **FORTH** require 64 Kbytes RAM. Disk formats available include: 8" standard CP/M SSSD, Northstar 5 1/4" QD, Kaypro 5 1/4", Apple 5 1/4", Micro-Mate 5 1/4", MS-DOS 5 1/4", Osborne 5 1/4", DD, and Sage. Most other formats can be special ordered. Dealer inquiries invited.

Z-80 is a registered trademark of Zilog, Inc.; CP/M is a registered trademark of Digital Research, Inc.; IBM is a registered trademark of International Business Machines Corp.; Augusta is a trademark of Computer Linguistics; PC/FORTH and PC/GEN are trademarks of Laboratory Microsystems Inc.



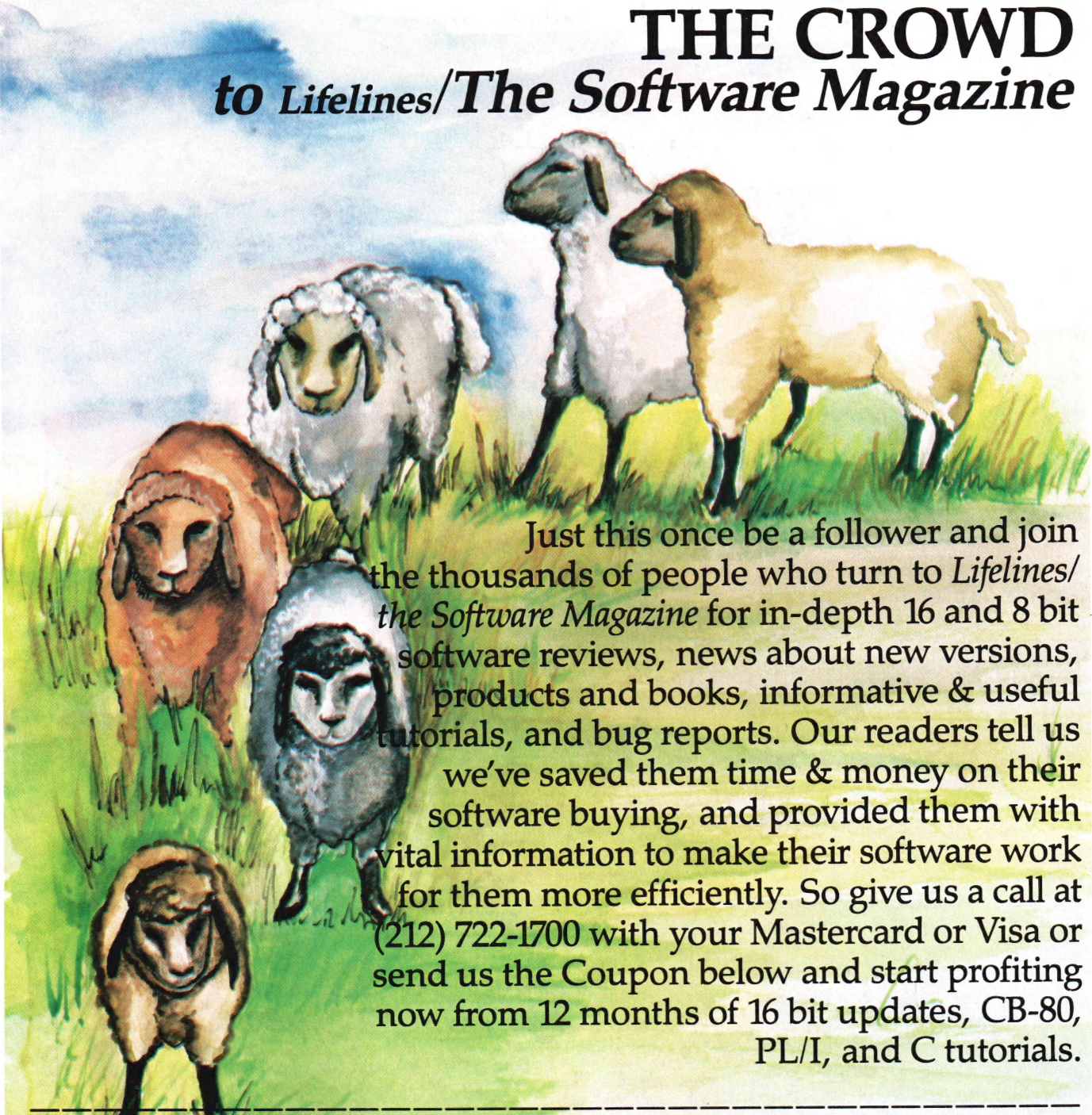
Laboratory Microsystems Incorporated
4147 Beethoven Street, Los Angeles, CA 90066
Phone credit card orders to (213) 306-7412



Circle no. 33 on reader service card.

FOLLOW THE CROWD

to Lifelines/The Software Magazine



Just this once be a follower and join the thousands of people who turn to *Lifelines/the Software Magazine* for in-depth 16 and 8 bit software reviews, news about new versions, products and books, informative & useful tutorials, and bug reports. Our readers tell us we've saved them time & money on their software buying, and provided them with vital information to make their software work for them more efficiently. So give us a call at (212) 722-1700 with your Mastercard or Visa or send us the Coupon below and start profiting now from 12 months of 16 bit updates, CB-80, PL/I, and C tutorials.

For \$24⁰⁰ in the U.S., Canada or Mexico (\$50⁰⁰ elsewhere) you can save 33% off the newsstand price.

☐ check or money order enclosed Name _____ Address _____
☐ Visa # _____ Exp. date _____
☐ Mastercard # _____ Exp. date _____

Signature _____

Lifelines/The Software Magazine, 1651 3rd Ave, NYC, NY 10128

A1

Dr. Dobb's Journal

For the Experienced in Microcomputing

May 1984
Volume 9, Issue 5

CONTENTS

ARTICLES

22 Introduction to Modula-2 for Pascal Programmers *by Hugh McLarty and David Smith*

Modula-2, Niklaus Wirth's latest language, has been compared to Pascal and even Ada. Many programmers may have been eyeing this successor to Pascal. This article compares features of the two languages, giving Pascal programmers an idea of what to expect in the Modula environment. (Reader Ballot No. 192)

28 Converting Fig-Forth to Forth-83 *by Ray Duncan*

In mid-1983 the Forth Standards Team adopted a new Forth standard, Forth-83. While this new standard provides a number of improvements, its incompatibilities with older versions of Forth can cause problems when trying to run old programs. The author (on brief sabbatical from his 16-bit Software Toolbox) discusses how to convert old Forth programs to Forth-83, including a checklist of things to watch for and a summary of the 83-Standard Forth vocabulary changes. (Reader Ballot No. 193)

37 Sixth Generation Computers *by Richard Grigoris*

The author has addressed Fifth Generation topics in previous issues of *Dr. Dobb's Journal* (December 1982 and August 1983). Now he turns to even more distant speculations by describing how the problem of increasing computational speed could be approached in the Sixth Generation. (Reader Ballot No. 194)

50 A New Library For Small-C *by James Hendrix and Ernest Payne*

In December 1982 and January 1983 we published James Hendrix's version 2.0 of the Small-C compiler, which contained a relatively meager library. This month we present a more sophisticated library incorporating several new Unix-like features, along with code that upgrades the compiler to version 2.1. Because of the size, the last part of Listing Two will be continued next month. (Reader Ballot No. 195)

82 The Accent Finder *by Eddy Vasile*

Many of us rely on sound and intuition for things like proper syllabic division of words, but computers must use more defined methods. Written as an exercise in the use of sets in Pascal, this program breaks Spanish words into syllables and determines where accents are to be placed. (Reader Ballot No. 196)

98 Solutions to Quirks in dBASE II *by Gene Head*

While dBASE II is very powerful, it does have some shortcomings. This is the first of several articles dealing with fixes to some of its quirks. Here the author shows how to add an INKEY function, allowing interruption of a long listing or printout without aborting the program entirely. (Reader Ballot No. 197)

DEPARTMENTS

6 Editorial

9 Letters

12 Dr. Dobb's Clinic

Optimizing Compilers; Timeless Language (Prolog); Prissy Program?; I Tell You Three Times; Computer Citizenship (Reader Ballot No. 190).

16 CP/M Exchange

IRD: No Longer A Mystery; CP/M Tidbits; OUT: and INP: - Making Them Work (Reader Ballot No. 191)

100 Of Interest

(Reader Ballot No. 198)

102 Advertiser Index

EDITORIAL

Editor-in-Chief: Michael Swaine
Editor: Reynold Wiggins
Managing Editor: Randy Sutherland
Contributing Editors: Robert Blum,
Dave Cortesi, Ray Duncan,
Anthony Skjellum, Michael Wiesenberg
Copy Editor: Polly Koch
Director of Operations: Beatrice Blatteis
Promotions Coordinator:
Jane Sharninghouse
Circulation: Sally Brenton
Advertising Sales: Alice Hinton,
Walter Andrzejewski
Production/Art Director: Shelley Rae Doeden
Production: Alida Hinton
Typesetting: Jean Aring
Cover Illustration: William Stewart

Otmar Weber
Publisher
Chairman of the Board
M&T Publishing, Inc.

C. F. von Quadt
Director
M&T Publishing, Inc.

Laird Foshay
President
M&T Publishing, Inc.

Dr. Dobb's Journal (USPS 307690) is published monthly by M&T Publishing, Inc., 2464 Embarcadero Way, Palo Alto CA 94303, (415) 424-0600, under license from People's Computer Company, Box E, Menlo Park, CA 94626. Second class postage paid at Palo Alto and at additional entry points. Address correction requested. Postmaster: Send Form 3579 to *Dr. Dobb's Journal*, 2464 Embarcadero Way, Palo Alto CA 94303.

Subscription Rates: \$25 per year within the United States \$44 for first class to Canada and Mexico. \$62 for airmail to other countries. Payment must be in U.S. Dollars, drawn on a U.S. Bank.

Contributing Subscribers: Christine Bell, W. D. Rausch, DeWitt S. Brown, Burks A. Smith, Robert C. Luckey, Transdata Corp., Mark Ketter, Friden Mailing Equipment, Frank Lawyer, Rodney Black, Kenneth Drexler, Real Paquin, Ed Malin, John Saylor Jr., Ted A. Reuss III, InfoWorld, Stan Veit, Western Material Control, S. P. Kennedy, John Hatch, Richard Jorgensen, John Boak, Bill Spees, R. B. Sutton. **Lifetime Subscribers:** Michael S. Zick, F. Kirk.

Foreign Distributors **UK & Europe:** Homecomputer Vertriebs HMBH 282, Fluegelstr. 47, 4000 Dusseldorf 1, West Germany; Euro Computer Shop, 182 Rue du Faubourg St. Denis, 75010, Paris, France; La Nacelle Bookstore, Procedure D'Abonnement 1-74, 2, Rue Campagne - Premiere, F-75014, Paris, France; Computercollectief, Amstel 312A, 1017 AP Amsterdam, Netherlands. **Asia & Australia:** AXCH Publishing, Inc., 4F Segawa Bldg. 5-2-2, Jingumae, Shibuya-Ku, Tokyo 150, Japan; Computer Services, P.O. Box 13, Clayfield QLD 4011, Australia; Computer Store, P.O. Box 31-261, 22B Milford Rd., Milford, Auckland 9, New Zealand. (Write for Canadian Distributors)

Entire contents copyright © 1984 by M&T Publishing, Inc. unless otherwise noted on specific articles. All rights reserved.

Changes come and trip all your traps. You retire to write that novel and you find yourself behind a desk again, doing calisthenics with metaphorical braces on your teeth. Life's like that.

It's like this.

This magazine began over eight years ago as *Dr. Dobb's Journal of Tiny BASIC Calisthenics and Orthodontia*, its slogan being "running light without overbyte," and its notion being to promote the kind of programming gymnastics that didn't waste a byte of then-precious memory. It was a good notion, and the best programmers on microcomputers gladly shared their insights on the pages of *Dr. Dobb's* without monetary remuneration. Over the years the magazine continued to distribute, discuss and promote exemplary software: Tiny BASIC made way for Tiny C, a miniature version of Ada and other virtuoso performances in computer calisthenics and orthodontia.

But changes come. Within the past year, *Dr. Dobb's* has started paying its contributors, expanded its editorial staff and become affiliated with M&T Publishing, a profit-making company. It seems fair to ask how much of the original spirit of the publication can survive such changes.

It's a question whose answer I care about. I've been reading and enjoying *Dr. Dobb's* for years, and recently, in the process of researching a book on the history of the micro-computer, I read all the early issues of the magazine. I came to love *Dr. Dobb's Journal* for its irreverence, its personality, its exuberant embracing of tough problems for their very toughness. I don't want it to lose those qualities.

It's not hard to imagine some sad scenarios for *Dr. Dobb's*. It abandons 8-bit software as obsolete and becomes a machine-specific magazine dedicated to some well-known 8088-based personal computer. It ignores any advances in computer architecture since 1979 and lives out its days recycling IMSAI technical notes. It "targets the home [or small business or knowledge worker] market" and disappears in the newstand colage. It fancies itself *Time* magazine and puts red borders on its covers.

Happily, I can promise that none of those scenarios will come to pass in the foreseeable future. Who I am is Mike Swaine, former Senior Editor at *InfoWorld*, and as of this issue, Editor-in-Chief of *Dr. Dobb's Journal*. My job is a new one; Renny Wiggins is still Editor. Renny promises, too.

Changes come, and significant changes are ahead for *Dr. Dobb's*, but changes, I think, that respect the magazine's traditions. You can expect the Doctor to experiment with some techniques (like an electronic bulletin board) for getting his methods of software distribution into the 1980's, but don't imagine that he'll abandon his interest in cheap, public-domain software. Expect coverage of the Macintosh computer, not because it's popular, but because good programmers are starting to do amazing things with it. Expect to see some industry leaders in the pages of the magazine, but not at the expense of new writers with something to say.

Expect to see coverage of good implementations of languages and system software and utilities, and occasionally some really unusual things. For example, this month, Renny has put together a rather orthodontic issue, including an introduction to Modulo-2 for Pascal programmers, Ray Duncan's piece on converting to the Forth-83 standard and an unusual article by Richard Grigonis of Children's Television Workshop on what he calls "sixth generation computers."

Next month we'll examine a much-discussed and much-purchased piece of software, Borland International's Turbo Pascal. If half the things that are claimed about it are true . . . but we'll find out next month.

Mike Swaine

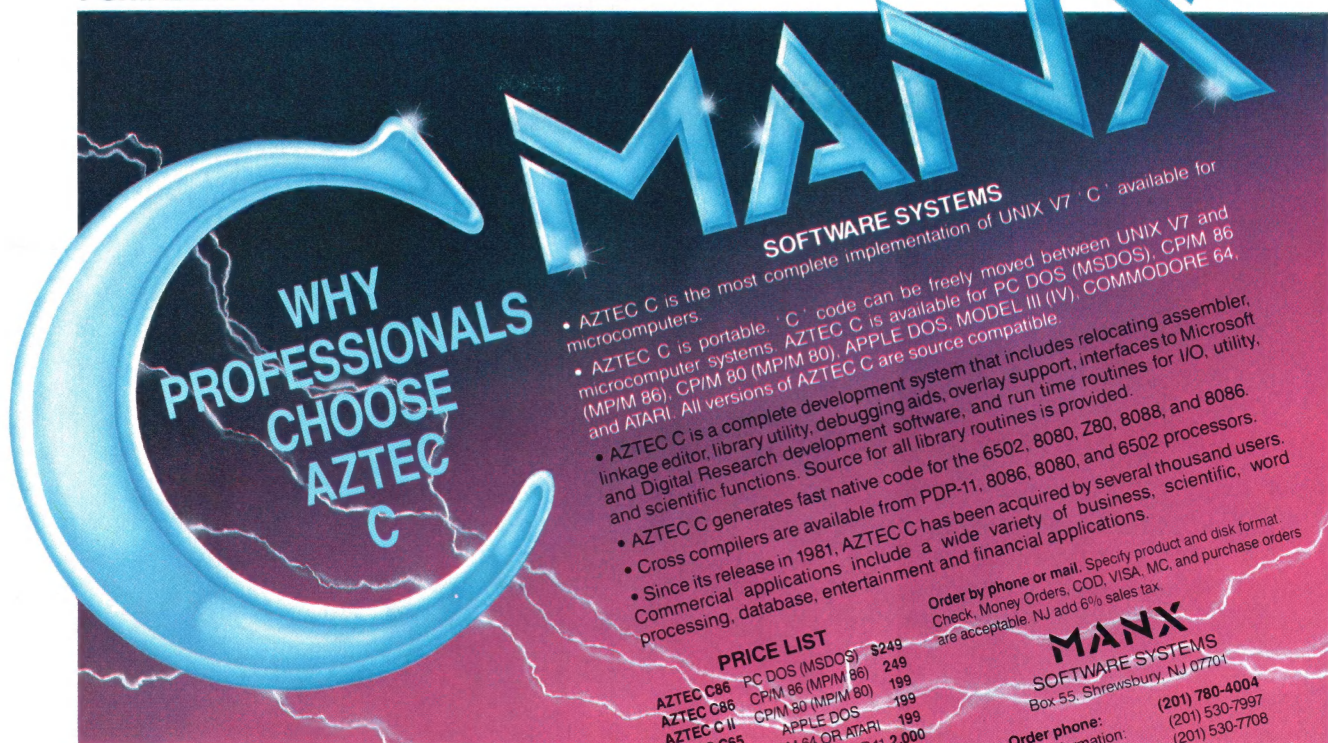
This Month's Referees

David Cortesi, Contributing Editor

David Clark, Pennsylvania State University

Clay Phipps, ACM

Henry Socha, SochaLogical Research



WHY PROFESSIONALS CHOOSE AZTEC C

SOFTWARE SYSTEMS

- AZTEC C is the most complete implementation of UNIX V7 'C' available for microcomputers.
- AZTEC C is portable. 'C' code can be freely moved between UNIX V7 and microcomputer systems. AZTEC C is available for PC DOS (MSDOS), CP/M 86 (MP/M 86), CP/M 80 (MP/M 80), APPLE DOS, MODEL III (IV), COMMODORE 64, and ATARI. All versions of AZTEC C are source compatible.
- AZTEC C is a complete development system that includes relocating assembler, linkage editor, library utility, debugging aids, overlay support, interfaces to Microsoft and Digital Research development software, and run time routines for I/O, utility, and scientific functions. Source for all library routines is provided.
- AZTEC C generates fast native code for the 6502, 8080, Z80, 8088, and 8086.
- Cross compilers are available from PDP-11, 8086, 8080, and 6502 processors.
- Since its release in 1981, AZTEC C has been acquired by several thousand users. Commercial applications include a wide variety of business, scientific, word processing, database, entertainment and financial applications.

PRICE LIST

AZTEC C86	PC DOS (MSDOS)	\$249
AZTEC C86	CP/M 86 (MP/M 86)	249
AZTEC C86	CP/M 80 (MP/M 80)	199
AZTEC C86	APPLE DOS	199
AZTEC C65	COM 64 OR ATARI	199
AZTEC C65	PDP-11	2,000
AZTEC Cross Compilers	Other	500

MANXX SOFTWARE SYSTEMS
Box 55, Shrewsbury, NJ 07701

Order by phone or mail. Specify product and disk format. Check, Money Orders, COD, VISA, MC, and purchase orders are acceptable. NJ add 6% sales tax.

Order phone: (201) 780-4004
Tech information: (201) 530-7997
Tech support: (201) 530-7708

Shipping: COD, 2nd day delivery, or Canada, add \$5. Canada 2nd day or US next day delivery, add \$20. Outside North America, add \$20, and for 2nd day add \$75.

Circle no. 38 on reader service card.

HOW FAST WOULD THIS PROGRAM RUN IF IT WERE COMPILED USING YOUR PASCAL COMPILER ?

PROGRAM SIEVE:
{ THE ERATOSTHENES' SIEVE BENCHMARK }

CONST SIZE = 8190;
TYPE BYTE = 0..255;
VAR I, PRIME, K, COUNT, ITER : INTEGER;
 FLAGS : ARRAY [0..SIZE] OF BOOLEAN;

```
BEGIN
  WRITELN( 'START' );
  FOR ITEM := 1 TO 10 DO BEGIN
    COUNT := 0;
    FOR I := 0 TO SIZE DO FLAGS[ I ] := TRUE;
    FOR I := 0 TO SIZE DO
      IF FLAGS[ I ] THEN BEGIN
        PRIME := I + 1 + 3;
        K := I + PRIME;
        WHILE K <= SIZE DO BEGIN
          FLAGS[ K ] := FALSE;
          K := K + PRIME;
        END;
        COUNT := COUNT + 1;
      END;
    END;
  WRITELN( COUNT, ' PRIMES' );
END;
```

Chances are, not as fast as it would if it were compiled using SBB Pascal.

As the following benchmarks show, SBB Pascal outperforms all other Pascal compilers for the PC in terms of speed, code size and .EXE file size:

	Execution Time (secs)	Code Size	.EXE File Size
SBB Pascal	10.90	181	4736
MS-Pascal	11.70	229	27136
Pascal/MT+ 86	14.70	294	10752
Turbo Pascal	15.38	288	9029

Development Package
\$350.00

Personal Use Compiler Package
also available
\$95.00

Call for free brochure with full benchmarks.



607/272-2807

Software Building Blocks, Inc.
Post Office Box 119
Ithaca, New York 14851-0119

SBB Pascal is a trademark of Software Building Blocks, Inc. MS-Pascal is a trademark of Microsoft Corporation. Pascal/MT+ 86 is a trademark of Digital Research, Inc. Turbo Pascal is a trademark of Borland International.

Circle no. 67 on reader service card.

Announcing *Dr. Dobb's*

Fifth-Generation Programming Competition

The Challenge: To write a program that applies artificial intelligence techniques to a practical problem, and to extend the present boundaries of what a microcomputer can do.

No rigorous definition of the field of artificial intelligence exists, but there are some programming problem domains that are commonly referred to as AI. These include, among others, pattern recognition, learning, logical reasoning, the representation of knowledge, planning and problem solving. Programs that make a stab at dealing with natural language or with speech or with visual input are regarded as AI programs, as are automatic-programming tools and chess programs.

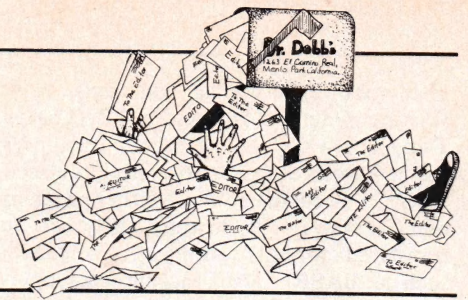
AI's earliest successes were in game playing, but recent work in the area of expert systems has shown that artificial intelligence techniques can be of real use in practical real-world problem areas like medical diagnosis, geological research and chemical identification. Perhaps because of the success of expert systems, which typically require the processing of large amounts of information, the belief is widespread that microcomputers are inadequate for AI work. We disagree. We believe that there are AI problems waiting to be solved via microcomputer, and we conceive this competition to challenge the brightest microcomputer programmers we know of — *Dr. Dobb's* readers — to find and solve some of those problems. A fantasy? Perhaps. But *Dr. Dobb's Journal* has been publishing Realizable Fantasies since 1976.

The Rules: The following items must be included in each entry: a functioning program on disk, a well-documented listing of the program, a prose description of the program explaining what it does and how it does it, and the entrant's name and address. The program must be written in a high-level language for a microcomputer, and the entry must be postmarked no later than September 30, 1984 and received by October 30, 1984 (*overseas entrants take note*).

Although your choice of specific language, hardware, problem domain and approach to the problem are all open, we offer some guidelines as to how we will be judging the entries. Your program will be judged for originality and significance of contribution first, and second on its intrinsic merits as a program: modularity of design, efficiency, portability, clarity, and so on. A program that executes in 64K of memory will get higher marks than an equivalent program that requires 96K, but a 128K program that does significantly more may rate higher than either. If your choice of hardware or disk format is an unusual one, you might query us before submitting your entry.

The Payoff: The winner will receive a \$1000 prize and will have the program and prose description published in *Dr. Dobb's*. In the tradition of *Dr. Dobb's*, this contribution to the advance of microcomputer software is to be placed in the public domain with full credit to the author. Support for the concept of public domain software is part of *Dr. Dobb's* heritage, but it may not be part of yours. This competition is for those who genuinely want to make a contribution to the advance of microcomputer software. Send your entry to:

Dr. Dobb's Journal, 2464 Embarcadero Way, Palo Alto, CA 94303.



The editorial response card is a great way to talk to us, but don't forget that Dr. Dobb's Journal also welcomes letters to the editor as a forum for ideas, innovations, irascibility and even idiosyncrasies. Some letters may be edited for clarity and brevity. The Doctor likes hearing from you — keep on writing.

Ackermann Elaborated

Dear Editor:

I am writing in response to the letter from Mr. Paul Condon (DDJ No. 88, February 1984). To logicians, Wilhelm Ackermann is best known in the context of Hilbert and Ackermann, *Mathematical Logic*, 1928. In 1926 David Hilbert asked whether all computable functions are primitive recursive. Ackermann found the answer in 1928, with Ackermann's function. (A translation of Ackermann's original article may be found in van Heijenoort, *From Frege to Gödel*, Harvard University Press, 1967. Ackermann, W., "On Hilbert's Construction of the Real Numbers.")

Primitive recursive functions are, roughly, those that can be computed from the simple functions of sum, product, power, and the operations of substitution, composition, and induction upon these. Ackermann's function is clearly computable, but can be shown to "increase" more rapidly than any primitive recursive function. (A good reference is Hans Hermes, *Enumerability, Decidability, Computability*, Springer-Verlag, 1969. Also many texts on formal language theory discuss Ackermann's function.)

The interest in the question of whether or not there exists a recursive, but not primitive recursive, function lay in determining if the mathematical definition of primitive recursion corresponds to our intuitive notion of "function computable by algorithm." Ackermann's function shows that primitive recursion does not; Church's Thesis, almost universally accepted, is the view that the broader class of recursive functions does correspond. There can be no exact mathematical demonstration that some class of mathematically definable functions does correspond to our intuitive ideas of computation, since the latter are necessarily imprecise.

Recursive functions expand the class of primitive recursive functions by allowing for the calculation of the least y such that $f(x=y)$ in, for example, the domain of natural numbers. Ackermann's function can fairly easily be seen to be

recursive; it can be calculated from the primitive recursive functions with the addition of this minimization feature. What this shows is that the induction in the definition of Ackermann's function is not "ordinary" induction.

Perhaps the minimization feature of recursive functions is what Mr. Condon is getting at with his concluding remark about the correctness or incorrectness of certain definitions of Ackermann's function. I haven't seen the definitions in question.

Beyond the testing of recursion in computing languages that he mentions, the only "use" that I know for the function is the theoretical one of categorizing classes of recursive functions. It is quite likely that Ackermann's function has some wider applications in recursion theory of which I am unaware; I can envisage applications in the study of proof theory for infinitary languages, via Gödel numbering, or just in infinitary proof theory. It sure is fast, isn't it?

Sincerely,
Jay Halcomb
Philosophy Department
University of Arizona
Tucson, AZ 85719

Dear Editor,

In a recent letter, Paul Condon inquired about the origin of Ackermann's function and asked of what use it is. Well, the story goes back to the mid 1920's when Wilhelm Ackermann was working with David Hilbert on an ambitious program to put the foundations of mathematics on a firm axiomatic footing. Among several topics they studied was a class of arithmetic functions, defined on the non-negative integers, which they called "primitive recursive functions."

An exact characterization of the primitive recursive functions is a little too technical for this note. Roughly speaking, however, they are anything you can get by starting with just constants and the successor function $S(n) = n + 1$, followed by rules of composition that allow one to plug one function into another as an argument and to define new functions by induction through the scheme $f(n + 1) = g(n, h(n))$ where g and h are functions previously defined by the same rules.

It turns out that the primitive recursive functions form a very large class. At that time it looked as though any func-

tion at all that was defined on the natural numbers and for all values of its arguments might in fact be primitive recursive. This question was raised by Hilbert in 1926. In particular, he asked: Can recursion be used to define a function that is not primitive recursive? The answer was given in 1928 when Ackermann came up with an example of such a function. But the original Ackermann function was not the same as the version that is currently fashionable. The original function had three arguments instead of two. The form currently popular (as quoted by Condon) is apparently due to Rózsa Péter in 1935, although she may have published earlier in some obscure Hungarian journal.

$$\text{Ack}(i, j) = \begin{cases} \text{if } i = 0 \text{ then } j + 1 \\ \text{else} \\ \text{if } j = 0 \text{ then } \text{Ack}(i - 1, 1) \\ \text{else} \\ \text{Ack}(i - 1, \text{Ack}(i, j - 1)) \end{cases}$$

Using Péter's form, suppose one defines a new function A of one argument by putting $A(n) = \text{Ack}(n, n)$. Then it can be shown (but not in this note) that the function $A(n)$ grows more rapidly with n than any possible primitive recursive function of one argument, and therefore that A is not itself a primitive recursive function. This is what Ackermann proved and what his function was designed to illustrate.

The growth rate of $A(n)$ is really mind-boggling. For comparison, consider the function $B(n) = n!!! \dots !!$ where there are n occurrences of the factorial sign. Now $B(n)$ is primitive recursive and its first few values are $B(0) = 0$, $B(1) = 1! = 1$, $B(2) = 2!! = 2$, and $B(3) = 3!!! = \dots$ well, $B(3)$ has 1747 decimal digits so I won't print it here. So $B(n)$ gets out of the starting gate fast and grows at such a fantastic rate that if the entire universe were filled with high-density floppies they wouldn't be sufficient to store the value of $B(4)$. On the other hand, the value of $A(3)$ is only 61, so $A(n)$ gets off to a slower start. But $A(4)$ is already enormously greater than $B(4)$, and $A(5)$ makes $B(5)$ look like an infinitesimal quantity.

The fact that Ackermann's function is defined by a double recursion makes it useful as one kind of check on correctness of the implementations of recursion in language interpreters and compilers. However, a recursive form of definition, of course, does not mean that a recursive language is necessary to evaluate a function (although it is sometimes not obvious how to do so in a nonrecursive manner). I

offer two little Pascal functions, ack1 (Listing One, below) and ack2 (Listing Two, below), each of which computes the same values as the recursively defined Ack(i,j) discussed above. Neither program uses recursive calls, so they easily can be translated for execution into languages such as BASIC. The function ack1 operates by "faking" an evaluation stack. The function ack2 is more mysterious because it uses so little storage and runs so much faster than the function ack1. The interested reader might want to figure out what is going on in these programs by inserting print statements that show the contents of the arrays after each iteration.

Sincerely,
Milton W. Green
440 Sherwood Way
Menlo Park, CA 94025

Telegovernment?

Dear Editor,

We are in a period where many voters feel their vote means nothing. They do not feel their elected representatives care what their constituents want. As a consequence more and more people have stopped voting.

Over the years the political control of our nation has become ever more centralized in the federal government. At the same time the population has become more decentralized politically. Who is your representative? Does your representative make any effort to keep up to date with the consensus of opinion in his/her district? What methods does your representative use to see that the people he/she represents know what he/she is doing?

Today, we have the basis for alternative methods of participation in government, as well as in other political activities. Computer-based telecommunications combined with television, either public or commercial, can provide the communications links required to return government to the people. An ever increasing number of families now have a computer or terminal in the home.

The time to start taking action regarding the application of telecommunications to government is now. By the time requirements and procedures have been decided we will already have enough users to implement any determinations made. It's also important to prevent, through early action, perversion of the potential power of political telecommunications by power groups.

One method of implementation might be to require every representative to maintain a telecommunications computer as part of his office equipment. This would be accessed from his district through an 800 number, the maintenance of which could be a part of the requirements of doing business, as a local or national monopoly, for the telephone companies.

We have entered a period of technology where government in the United States can once again be of the people, for the people, and by the people. The development of television as an educational medium, teletext, and computer-based telecommunications makes this potentially possible. The continuing reduction in hardware costs makes it economically viable.

This proposal does not advocate an end to representative government at any level. Instead it would return the same control to the electorate enjoyed by the electorate in 1776. We would still need our present legislative, judicial, and executive institutions as they are now constituted; direct democracy allows no check or time delay on temporary and emotional public reaction.

It's necessary for us to implement special education on various policy prob-

lems. The need for national "town meetings" has reached a critical level.

It is my wish to start a national organization to investigate, analyze, discuss, and possibly start implementation of public participation in government through telecommunications, television, etc. Anyone interested in participating should feel free to contact me. It will be difficult for me as an individual to provide the initial start of such an organization. This is based on both time and finances available, but I will endeavor to do my best.

Yours truly,
D. R. Crago
P. O. Box 728
Placentia, CA 92670

DDJ

Letters (Text begins on page 9)

Listing One

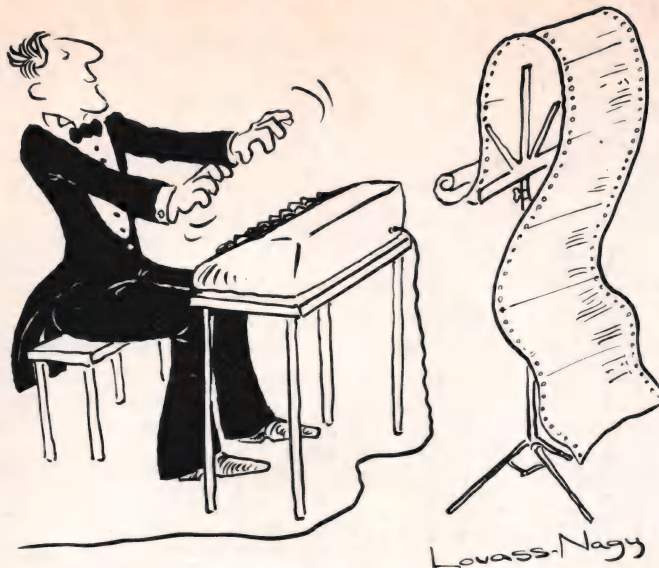
```
function ack1(i, j: integer): integer;
var p: integer; a: array[0..4000] of integer;
begin
  a[0] := i; a[1] := j; p := 1;
  repeat
    if a[p-1] = 0 then begin
      a[p-1] := a[p]+1; p := p-1 end else
      if a[p] = 0 then begin
        a[p] := 1; a[p-1] := a[p-1]-1 end else begin
          a[p+1] := a[p]-1; a[p] := a[p-1];
          a[p-1] := a[p-1]-1; p := p+1 end
        until p = 0;
      ack1 := a[0]
    end;
```

(End Listing One)

Listing Two

```
function ack2(i, j: integer): integer;
label 1, 2, 3;
var p: integer; a, b: array[0..6] of integer;
begin
  for p := 0 to 6 do begin a[p] := 1; b[p] := -1 end;
  1: b[0] := b[0]+1; a[0] := b[0]+1; p := 0;
  2: if (i = p) and (j = b[p]) then goto 3;
    if b[p] <> a[p+1] then goto 1;
    p := p+1; b[p] := b[p]+1; a[p] := a[0]; goto 2;
  3: ack2 := a[0]
end;
```

(End Listings)



•NEW PRODUCTS•

Before Johann Sebastian Bach developed a new method of tuning, you had to change instruments practically every time you wanted to change keys. Very difficult.

Before Avocet introduced its family of cross-assemblers, developing micro-processor software was much the same. You needed a separate development system for practically every type of processor. Very difficult and very expensive.

But with Avocet's cross-assemblers, a single computer can develop software for virtually any microprocessor! Does that put us in a league with Bach? You decide.

The Well-Tempered Cross-Assembler

Development Tools That Work

Avocet cross-assemblers are fast, reliable and user-proven in over 3 years of actual use. Ask NASA, IBM, XEROX or the hundreds of other organizations that use them. Every time you see a new microprocessor-based product, there's a good chance it was developed with Avocet cross-assemblers.

Avocet cross-assemblers are easy to use. They run on any computer with CP/M* and process assembly language for the most popular microprocessor families.

5¼" disk formats available at no extra cost include Osborne, Xerox, H-P, IBM PC, Kaypro, North Star, Zenith, Televideo, Otrona, DEC.

Turn Your Computer Into A Complete Development System

Of course, there's more. Avocet has the tools you need from start to finish to enter, assemble and test your software and finally cast it in EPROM:

Text Editor VEDIT -- full-screen text editor by CompuView. Makes source code entry a snap. Full-screen text editing, plus TECO-like macro facility for repetitive tasks. Pre-configured for over 40 terminals and personal computers as well as in user-configurable form.

CP/M-80 version \$150
CP/M-86 or MDOS version \$195
(when ordered with any Avocet product)

EPROM Programmer -- Model 7128 EPROM Programmer by GTek programs most EPROMS without the need for personality modules. Self-contained power supply ... accepts ASCII commands and data from any computer through RS 232 serial interface. Cross-assembler hex object files can be down-loaded directly. Commands include verify and read, as well as partial programming.

PROM types supported: 2508, 2758, 2516, 2716, 2532, 2732, 2732A, 27C32, MCM8766, 2564, 2764, 27C64, 27128, 8748, 8741, 8749, 8742, 8751, 8755, plus Seeq and Xicor EEPROMS.

Avocet Cross-assembler	Target Microprocessor	CP/M-80 Version	•CP/M-86 IBM PC, MSDOS** Versions•
•XASMZ80	Z-80		
•XASM85	8085		
XASM05	6805		
XASM09	6809		
XASM18	1802		
XASM48	8048/8041		
XASM51	8051		
XASM65	6502		
XASM68	6800/01		
XASMZ8	Z8		
XASMF8	F8/3870		
XASM400	COP400		
XASM75	NEC 7500		
Coming soon: XASM68K...68000			
		\$200.00 each	\$250.00 each
			\$300.00 each
		\$500.00	

(Upgrade kits will be available for new PROM types as they are introduced.)

Programmer \$429

Options include:

- Software Driver Package --
- enhanced features, no installation required.
- CP/M-80 Version \$ 75
- IBM PC Version \$ 95
- RS 232 Cable \$ 30
- 8748 family socket adaptor ... \$ 98
- 8751 family socket adaptor ... \$174
- 8755 family socket adaptor ... \$135

- **G7228 Programmer by GTek** -- baud
- to 2400 ... superfast, adaptive programming algorithms ... programs 2764 in one minute.

• Programmer \$549

- Ask us about Gang and PAL programmers.

- **HEXTRAN Universal HEX File Converter** -- Converts to and from Intel,
- Motorola, MOS Technology, Mostek,
- RCA, Fairchild, Tektronix, Texas
- Instruments and Binary formats.

- Converter, each version \$250

Call Us

If you're thinking about development systems, call us for some straight talk. If we don't have what you need, we'll help you find out who does. If you like, we'll even talk about Bach.

CALL TOLL FREE 1-800-448-8500
(In the U.S. except Alaska and Hawaii)

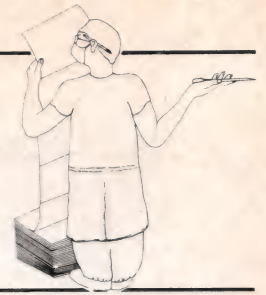
VISA and Mastercard accepted. All popular disc formats now available -- please specify. Prices do not include shipping and handling -- call for exact quotes. OEM INQUIRIES INVITED.

*Trademark of Digital Research **Trademark of Microsoft



AVOCET SYSTEMS INC.™

DEPT. 5-84 DDJ
804 SOUTH STATE STREET
DOVER, DELAWARE 19901
302-734-0151 TELEX 467210



by D.E. Cortesi, Resident Intern

Optimizing Compilers

We asked for help finding a reference to what we thought was the first optimizing compiler, and we got some good responses, of which the most notable came from C. W. Medlock:

"I believe you are referring to IBM's Fortran H compiler for the IBM 360/370. As to the reference to this work that you are seeking, I believe that you are referring to our paper, "Object Code Optimization," *Communications of the ACM*, Vol. 12, No. 1 (January 1969), written by myself and E. S. Lowry.

"It would be unfair, however, to claim that we were co-authors of the *first* optimizing compiler. Indeed, credit belongs to such early pioneers as John Backus and his original crew for the fine job they did in generating the most-efficient code that the early versions of even IBM 704 Fortran turned out. Many think that it was the quality of this code (compared to that produced by earlier compilers) that convinced the computing community of the feasibility of using high-level languages at all!

"While we know of no other full use of these techniques in another compiler (and quite frankly wish we could find such a compiler for the C language for the IBM PC), there is at least one company, Computer Innovations, that claims to have such a compiler. We haven't been able to test it to see just how 'optimized' the code it produces really is.

"As to the optimization technique that Ed Lowry and I developed, it relies heavily upon tracing the flow of both data and control within a program to see which code items can be moved to a less-frequently-traversed portion of the program (or eliminated entirely as either redundant or producing output that would never be used), and to assist with the temporary assignment of variables to registers over the most frequently executed portions of the code. This analysis was performed over the entire compilation and the technique was thus called 'Global Program Optimization'."

Another reader, Owen Montgomery, also wrote to point out the importance of the early Fortran compilers. He says, "Fortran I was the first algebraic optimizing compiler. At the inception of the Fortran project by John Backus's team at IBM in 1954, most programming was done in machine code or simple assemblers. So-called automatic coding sys-

tems existed but would be regarded as little more than symbolic assemblers with built-in function libraries by today's standards. Fortran, to be successful, had to produce very efficient object code. If not optimum and on a par with hand-coded programs, it would surely fail. The consensus among programmers of the day was that efficient programming could not be automated."

Owen's letter included an illuminating quote from a paper by Backus, "The History of FORTRAN I, II, and III," *ACM SIGPLAN Notices*, Vol. 13, No. 8, August 1978. Read it carefully:

"It was an exciting period; when later on we began to get fragments of compiled programs out of the system, we were often astonished at the surprising transformations in the indexing operations and in the arrangement of the computation which the compiler made, changes which made the object program more efficient but which we would not have thought to make as programmers ourselves . . . Transfers of control appeared which corresponded to no source statements, expressions were radically rearranged, and the same DO statement might produce no instructions in the object program in one context, and in another it would produce many instructions in different places in the program."

A very few times we've had the experience of being delighted by the clever object code a compiler generated, but never on a personal computer. On the contrary, the personal compilers we've used have produced the duller, most predictable, most flat-footedly literal translation one could imagine.

The entertainment value of the code is not the issue, of course. The crux of the matter is that a genuine optimizer can produce the kind of low-level, foxy cleverness that an assembly programmer sweats to invent — and does it by mechanical methods. That liberates the programmer; the brain power he or she would have spent on achieving tight code can instead be applied where it really matters: on the algorithm.

What we'd like to know is, if Backus could accomplish this in 1954; if Lowry and Medlock could do it in 1969; if the techniques can be found in any of a dozen computer-science textbooks; *why don't we have such compilers today?*

Timeless Language

Meanwhile, we've been exploring the other end of the language spectrum. As

part of a continuing (and probably futile) attempt to keep up with the state of the art, your Intern has been studying PROLOG. That's the language that figures heavily in the Japanese plan to produce the Fifth Generation of computers. It is, effectively, an executable variant of the notation of format predicate logic.

At the moment, most implementations of PROLOG are handcrafted prototypes running in university computer centers, primarily in Europe. However, one implementation is a real, commercial product. Known as micro-PROLOG, it's published by Logic Programming Associates Ltd. (10 Burntwood Close, London, England SW18 3JU; \$275, shipping included). We recommend it. The manuals are more than adequate; the software works; and the package was delivered across half the world faster than some we've ordered from across the state.

Micro-PROLOG is a fascinating piece of software in itself, entirely aside from the intrinsic fascination of an entirely new language. At its core is a small, fast Z80 interpreter for a list-processing language, one that is strongly reminiscent of LISP, but augmented with pattern-matching primitives. This implements the core of PROLOG, because the core of a PROLOG interpreter is a recursive, backtracking pattern-matcher.

The rest of the system is implemented in PROLOG. This is impressive, because "the rest" includes everything that makes the system usable, including an interactive front end that hides the LISP-like parenthesized notation under a more natural syntax. This gives one confidence in two ways: it demonstrates that PROLOG is a "real" language, since it can be used to write non-trivial software; and it affords proof that the core system is well-tested, since it can execute its own front end.

PROLOG is something else again, it requires the same kind of head-spinning reorientation that accompanies a move from, say, Pascal to Fort, or from COBOL to APL. The most difficult part, at least for this student, is that PROLOG contains no concept of *time*. Every other language we've used contains an implicit notion of movement in time: the computer will do this *and then* it will do that.

In PROLOG, every statement of a program is a candidate for execution at every moment. Actually, "statement" is a poor term for a programmer to use in describing a line of PROLOG; it carries too many implications from other lan-

guages. "Assertion" is a better term; a PROLOG program is composed of a number of assertions about the world. In principle, all assertions are executed at once, in parallel, and those that turn out to be false are discarded. (In practice, the interpreter tries them sequentially, but it isn't cricket to assume that.) It's this inherent parallelism that makes PROLOG a candidate for the system language of the Fifth Generation machines, but boy! does it twist your mind at first.

The micro-PROLOG system includes a hands-on tutorial that serves to get you just barely started. Two other books may help. *Programming in PROLOG* by W. F. Clocksin and C. S. Mellish (Springer-Verlag, 1981) is a reasonably good textbook on the use of the language. *Logic for Problem Solving* by Robert Kowalski (North-Holland/Elsevier, 1979) is an exhaustive, scholarly exploration of the relationship between Horn-clause logic (which PROLOG implements) and everything else in the world. It is heavy going, and parts are interesting only to an implementor of PROLOG, not to a user of it. Still, parts of Kowalski's book explain the rationale behind this initially puzzling language.

One warning: the syntax of PROLOG is nowhere near standardized. Micro-PROLOG seems to be full PROLOG as described by Clocksin and Mellish (it may even be a superset). However, the syntax of micro-PROLOG has many differences of detail from that used by Clocksin and Mellish, and that in turn is different from the syntax that Kowalski uses. It is not difficult to translate from one to another, but it imposes an extra mental load.

Are any readers also exploring PROLOG? Somebody must be, because our local bookstore can't keep *Programming in PROLOG* in stock. Write and share your experiences.

Prissy Program?

Oscar Goldman writes to ask, "Did you know that RMAC is a delicate flower who turns her (his? its?) head in embarrassment at the presence of an error? Take a look at this listing:

```
0000 3A0600 1da store
      inra ; typographical error
0003 320600 sta store
0006 00 store: db 0
      end
```

It took me quite a while to debug a program which had just that typo (of 'inra' for 'inr a'). I think you might warn your readers of this one."

With pleasure, Oscar. What we have here is the result of the peculiarly flexible syntax of the Digital Research assemblers.

Typical assemblers require a label to begin in column 1 of a statement. That permits a simple test for the presence of a label: if column 1 is blank, there isn't

one. The DRI assemblers (ASM, MAC, RMAC) have a more complicated rule. They isolate the first word of a statement and look for it in the table of known operation codes and in the table of defined macro names. If the first word is not an opcode or a macro, it must be a label.

That's what happened here: since "inra" isn't an opcode, RMAC decided it must be a label. It shows up in the symbol table listing. The fact that it was indented to line up with the other opcodes made no difference at all.

This syntactic scheme can be useful; you can define pseudo data structures, indenting inner names under the names that contain them. However, as Oscar notes, it can also let you create some very tricky bugs.

I Tell You Three Times

Another correspondent, Michael Barr, writes with a tale of keyboard handling in MSDOS 2.0. We don't have an MSDOS machine on which we can test his claims, but perhaps a reader can test and explain them. Here is his account.

"I have discovered a peculiar effect of control-S. To see it, at the system prompt simply type control-S. Do it again, then a third time. Try it three more times. Now press control-S, followed by any ordinary character, then control-S again. Confused? So was I.

"There are two DOS functions that are relevant. The first is function 7, which goes into a loop until you type a character and then returns that character. It works as documented. The second is function

"Q-PRO 4 blows dBASE II away

We now complete complex applications in weeks instead of months."

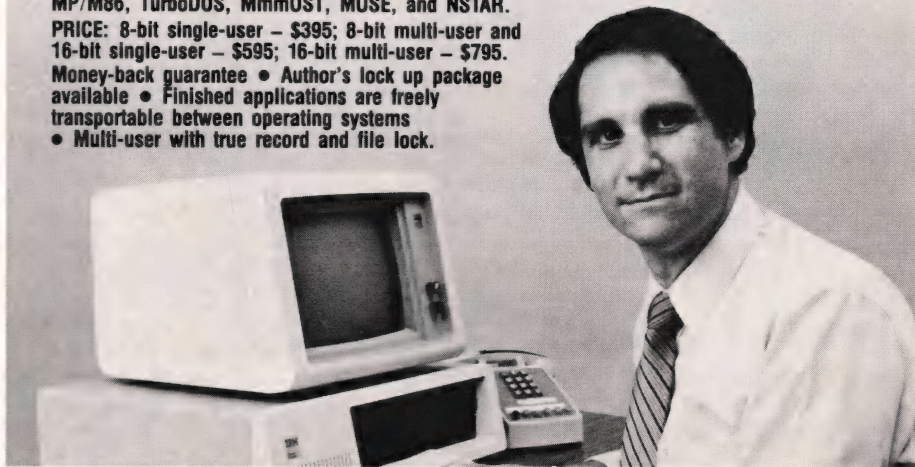
says Q-PRO4 user, Richard Pedrelli, President, Quantum Systems, Atlanta, GA

“As a dBASEII beta test site the past two years, we were reluctant to even try Q-PRO4. Now we write all our commercial applications in Q-PRO4. We find it to be an order of magnitude more powerful than dBASEII.

We used Q-PRO4's super efficient syntax to complete our Dental Management and Chiropractic Management Systems much faster. Superb error trap and help screen capabilities make our finished software products far more user friendly, too.

In my estimation, any application programmer still using outdated 3rd generation data base managers or worse, a 2nd generation language like BASIC, is ripping himself off."

Runs with PC DOS, MS-DOS, CP/M, MP/M, CP/M86, MP/M86, TurboDOS, MmmOST, MUSE, and NSTAR.
PRICE: 8-bit single-user - \$395; 8-bit multi-user and 16-bit single-user - \$595; 16-bit multi-user - \$795.
Money-back guarantee • Author's lock up package available • Finished applications are freely transportable between operating systems
• Multi-user with true record and file lock.



For Q-PRO 4 demonstration, go to nearest MicroAge store or other fine dealer.

quic·n·easi products inc.

136 Granite Hill Court, Langhorne, PA 19047 (215) 968-5966 Telex 291-765

CP/M, MP/M, CP/M86, and MP/M86 are trademarks of Digital Research. TurboDOS, MmmOST, MUSE, NSTAR, MS-DOS and PC DOS are trademarks of Software 2000, Intellivision Systems, O.S.M., Molecular, Microsoft and IBM, respectively.

11, which is documented to return a true flag only if there is a character waiting in the keyboard buffer. What it actually does is another matter.

"After the first control-S, that character is in the buffer (as can be determined with either function 6 or function 7), but function 11 swears the buffer is empty. After another keypress, whether control-S or another character, assuming you have not gotten the first control-S out of the buffer, the buffer is *empty* while function 11 returns a *true* flag.

"What happens after the third keystroke? Well, that is exactly like the first. Why, then, do you actually get a character that third time? I can only speculate that

the command interpreter in DOS operates in the same way as a program of mine. What my program did was to call function 11 until returned a true flag, then call function 7 to get the character. That way the program could do something else instead of just idling until there was input. (It wasn't doing anything terribly urgent — it was polling location 0000:0417 hex to find out if the Caps Lock key had been pressed.)

"The first entry of control-S had no effect on function 11, while the second caused function 11 to return a true flag with the buffer empty. Then the program called function 7, which just idled until another character was entered. Thus every third keystroke was captured. I speculate

that the DOS command interpreter is doing likewise."

We can't check out Barr's problem, but here's a hint for any reader who wants to look into it. It's suggestive that the problem centers on control-S. That's XOFF, or DC3, and in many systems it would be a signal to freeze screen output until a control-Q (XON, DC1) was entered. MSDOS contains a number of half-assimilated CP/M compatibilities (Barr also mentions the undocumented feature that control-P will toggle printer echo of the screen output, which is a CP/M convention). CP/M 2 uses control-S to freeze the screen, releasing the screen when any further key is hit. Both keystrokes are swallowed in the system. Maybe that's what MSDOS is trying to do, but not thoroughly enough.

Computer Citizenship

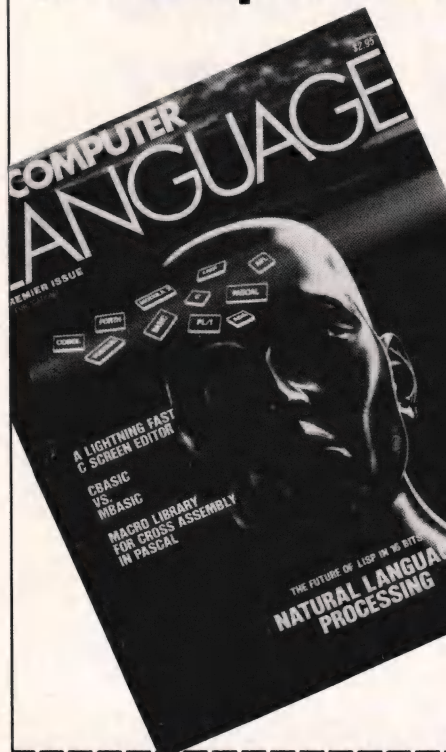
However, another point in Barr's letter raises our hackles. In our oh-so-humble opinion, polling loops are bad! A program that refuses to read the keyboard until its poll shows that a character is waiting is a bad citizen; it defeats any number of nice features that the DOS could otherwise implement. It defeats the largest benefits of a buffered keyboard (see this column for May 1983, under the heading "Software vs. Common Sense").

Furthermore, a polling program is absolutely deadly in a multitasking system. It always uses its full slice of time even when it has nothing to do; that defeats the basic idea of multitasking, which is that one task can make good use of another task's idle time. And multitasking systems are coming to micros: Concurrent CP/M is available now, and MSDOS 3.0 is rumored to be one.

Sure, a Caps Lock flag on the status line is a cute feature, but consider: Under Concurrent CP/M, a program like Barr's would be checking the Caps Lock byte at times when the user was entering data to a completely different program. The same problem would probably occur under Microsoft Windows(tm) or VisiOn(tm) — it would be polling Caps Lock when the cursor was in another program's window.

This is an example of how a solution can go wrong when it is implemented at the wrong level of the system. The PC keyboard lacks two 29-cent LEDs to display the state of Caps Lock and Num Lock. The PC operating system does nothing about it. So application programmers try to make up for it, either with a polling loop or by stealing the keyboard interrupt vector. And all the ones whose efforts succeed end up with programs that flat *won't work* in systems where the hardware is a resource that has to be shared among multiple programs. ■■■

At last! The first magazine dedicated to computer languages.



Your source for the latest technical skills and methods used by software specialists.

Written for people who write serious code, COMPUTER LANGUAGE will cover major developments in the software design field, from theory to implementation. COMPUTER LANGUAGE will focus on the most important and useful language and software design information available in the fast moving microcomputer industry.

A Magazine Written for the Person Who Takes Computing Seriously.

We're talking about you — the experienced software author, programmer, or engineer who routinely programs in two or more high-level languages. A person who understands the creative nature of programming and appreciates the beauty of efficient code in action.

COMPUTER LANGUAGE WILL Constantly Challenge Your Abilities.

The foremost industry experts will discuss:

- Algorithmic Approaches to Problem Solving
- Language Portability Features
- Compiler Designs
- Useful Utilities
- Artificial Intelligence
- Editors
- New Language Syntax
- Telecommunications
- Language Selection Criteria
- Marketing Your Own Software
- Critical Software and Hardware Reviews

Plus, columnists and reader forums will put you in touch with the latest developments in the field.

Send to:

COMPUTER LANGUAGE

2443 Fillmore Street
Suite #346
San Francisco, CA 94115



YES! Start my charter subscription with the premier issue of COMPUTER LANGUAGE. My 1 year charter subscription is just \$19.95, a \$15 savings under the single copy price. Guarantee: I can cancel my subscription at any time for a full refund.

☐ \$19.95

☐ Bill me.

Payment Enclosed

Name _____

Address _____

City _____ State _____ Zip _____

Circle no. 15 on reader service card.

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 190.

LIFEBOAT™ Associates:
The full support software
source.

Reach for the programming horizon of the 80's with Lattice™ C, the fastest C compiler.

Set the course of your next software project towards greater power and portability by selecting Lattice C, recognized as the finest and fastest 16-bit C compiler. Lattice C, the full implementation of Kernighan and Ritchie, continues to lead the way by announcing full memory management up to 1 Megabyte. Major software houses including Microsoft, MicroPro™ and Sorcim™ are using Lattice C to develop their programs.

Lifeboat offers Lattice C with a tested set of software tools to provide a complete development system including:

HALO™
PANEL™
PMATE™
PLINK™-86
C-FOOD SMORGASBORD™
LATTICE WINDOW™
FLOAT87™

Lattice C is available for a wide variety of 16-bit personal computers including IBM®, NCR®, Texas Instruments, Victor, Wang and other microcomputers running PC™-DOS, MS™-DOS and CP/M86™.

Call LIFEBOAT at 212-860-0300 for free information on the Lattice C family of software development tools.

LIFEBOAT

Associates

Color graphic primitives
Screen design aid
Customizable program editor
Overlay linkage editor
Screen and I/O utilities
Multi-window functions
8087 floating point math

LIFEBOAT

Associates

1651 Third Avenue
New York, NY 10028
212-860-0300

Please send me free information on:

- ☐ Lattice and development tools
- ☐ Corporate purchase program
- ☐ Dealer program
- ☐ OEM agreements
- ☐ Send me the complete LIFEBOAT software catalog. \$3.00 enclosed for postage and handling.

Name

Company

Address

City

State

Zip

Telephone

LATTICE C-FOOD SMORGASBORD and
LATTICE WINDOW, TM: Lattice, Inc.
MICROPRO, TM International Corp.
SORCIM, TM Sorcim Corp.

LIFEBOAT, TM Intersoft Corp.
HALO, TM Media Cybernetics
PANEL, TM Roundhill Computer, Ltd
PMATE and PLINK, TM Phoenix Software

FLOAT87, TM Microfloat
IBM and PC, ® TM International Business Machines
MS, TM Microsoft
CP/M86, TM Digital Research

by Robert Blum

A few months ago, Terje Bolstad of Norway wrote to ask if I had any experience with an undocumented device he had found in PIP called IRD:. Unfortunately, I had no prior knowledge of the IRD: device to share but was intrigued, as many of you have been, with its origin and possible purpose. I decided to go directly to the mountain for further advisement.

My first letter to DRI was promptly answered. Rather than being provided with an answer, however, I was referred for an explanation to the OEM from whom I had purchased my CP/M system. Since several of us had already done considerable research on how IRD: worked, I didn't feel that a side trip to another vendor was necessary. I wrote to DRI again to explain more fully what steps had been taken to decipher the mystery device's purpose. The response to my second letter came via a phone call, but to no avail because the answer was considered to be proprietary information of DRI.

One further encounter with DRI proved to be no more fruitful than the first two. Undaunted, I took my quest for knowledge to the readers of this column in January. To stimulate the juices of adventure I offered a *DDJ* tee shirt to the author of the best answer.

I should have known what would happen next. However, I was caught off guard when my mail box began to fill with more than my usual quota of correspondence. Your responses to my request for help ranged from a few lines jotted on a postcard to catalog-sized envelopes overstuffed with program listings. As is always the case, and very pleasantly so, when dealing with *DDJ* readers the answers were most insightful and gave evidence to a great deal of work.

It would be impossible to print all the responses that I received. With the exception of some editing, what follows is a cross section of your answers to the IRD: mystery.

IRD: No Longer A Mystery

Dear Bob,

I've just seen your column in the January issue of *Dr. Dobb's*. There really is no mystery about the device called IRD:. The letters "IRD" stand for "Infra-Red Detector." The IRD: device represents a peripheral device whose purpose, clearly, is to monitor the infra-red level in its vicinity. This can be used for various purposes, for instance, to shut down the com-

puter when the programmer's temperature rises above a certain critical level because of CP/M's idiosyncrasies. But the truth, actually, is this: In the beginnings of CP/M, Kildall and associates used to engage in target practice using guns which emitted infra-red (instead of water) and had several IRD's installed in the targets to record their hits.

Oscar Goldman

Dear Robert,

I was so interested in your PIP mystery device that I had to solve the problem before I went to sleep. It seems that the IRD: driver is for the Intellec-8/Icom Reader. On my system PIP hangs (actually it keeps returning 07fh, which never signifies end of file). A very tight routine within PIP is entered and then sometimes never exited when the IRD: device is used. See Listing One (page 18) for the IRD: subroutine taken from PIP version 1.5.

Craig D. Miller

Dear Robert,

Internal Research and Development? Infra Red Device? Irreversible Route to Delirium?

No, the mystery device is, in fact, the Intel Paper Tape ReaDer. Does anyone remember paper tape? Yes, PIP contains a built-in hardware driver for this device which is (was) used with the Intel Intellec-8 MDS system. At least this was true with the V1.4 version of PIP, and I assume the CP/M 2.2 version follows suit.

As for the details, the following actions are performed when each byte is read from the IRD: device during a PIP transfer:

- (1) The value OCH is output to port 01H.
- (2) The value 08H is output to port 01H. This strobes the paper tape reader mechanism.
- (3) PIP loops until bit 5 of port 01H is set to 1. This is the Ready bit.
- (4) Finally, the lower 7 bits of port 03H are returned as the input value.

Note that if a system does not contain I/O ports 1 or 3, the net effect of all this will be to return a neverending string of 7fh's, which is what you observed.

IRD: is, no doubt, useless on 99% of CP/M-based systems. In fact, it could be dangerous on systems which use these I/O ports for other purposes.

Now that you know about the Irresistible Riddle to Decode device, you might want to buy an Intellec-8 system in order

to realize the full potential of your CP/M software.

Rick Hollinbeck

Dear Mr. Blum:

I think I can shed a little light on the mystery of the IRD: device in CP/M 2.2's PIP.COM. The code appears to drive a strobed parallel input port device. To the best of my recollection, the earlier Intel MDS/Intellec systems have a paper type reader addressed at these port addresses. This suggests that IRD: stands for Intel ReaDer. The reason it performs differently on various systems now becomes clear — it depends on what sort of device (if any) you have addressed at these port addresses. If you don't have any device on port 03h, you will (hopefully) input an FFh which will be masked to 7Fh, which is what you got in your disk file.

This is most likely a remnant of the days when CP/M was still being developed, and that is why Digital Research doesn't like to discuss it. Remember, the original CP/M was primarily written in PL/M, hosted on an Intel development system. They had to read the CP/M utility object tapes somehow, and this is probably how they did it.

Terence M. Kennedy

Dear Robert,

It should be obvious to everyone that IRD: is DRI spelled backwards. However, since acronyms have to stand for something, and Inc. Research Digital sounds really horrible, I propose we christen our device (DRI seems to want to disown the poor child) "Interminable Repetitious Device," in honor of its propensity for generating an endless stream of s's.

I'm sure that if we devote enough collective effort, we can find practical uses for IRD:. In fact, I have already thought of one: By PIPing IRD: to a disk file, we have a convenient, fast way of generating a large file in order to test some program.

David Kettle

Dear Bob,

I suspect that IRD: is simply DRI backwards. If it has to have a meaning, perhaps it would be "Incorporated Research Digitalizer," or some such.

Roy Lipscomb

Dear Sir:

ARD:, IRD:, PRN: — three popular peripheral devices.

This is explained in the documentation for CP/M V1.3, copyrighted by Digi-

tal Research, dated 1976. When the new guide was printed and stapled into a neat booklet the meanings were deleted and PIP.COM was improved. Apparently, PIP's internal table was not completely changed, thus a remnant still exists:

ARD: Addmaster paper tape reader
 IRD: Intel or Icom paper tape reader
 (these two were considered high-speed vs. the ASR-33)
 PRN: Tally hard copy printer

There is also a table of error messages in PIP.COM that seem peculiar because I have not seen them reported before: tape stopped or illegal HEX character encountered. The document also explained this in the paragraph about PIP.COM special functions when processing a punched paper tape. I now suspect they are related to ARD: and IRD: as they were never used when I assigned a cassette tape to PUN:/RDR:.

As you may have guessed, I have been an owner of a CP/M operating IMSAI system since November 1976 and, though not having an ASR-33 as a terminal, I did experience punched paper in those historical days.

Delmar Rawson

There you have it, Terje. IRD: stands for Intel-Icom-Inteltec-8 ReaDer and was used on that system for reading paper tape. Why all the secrecy about the IRD: device? All we can do is guess, but I am betting that DRI still has an Intel system or two being used daily by one of Jerry Pournelle's mad friends.

Before I forget, my heartiest congratulations go out to Delmar Rawson. He was not only fast but also correct. His DDJ tee shirt is on its way.

I would also like to express my thanks to each of you who helped me in finding the answer to the mystery IRD: device.

CP/M Tidbits

Included with Terence Kennedy's response to the IRD: mystery were a few insights into how CP/M does its job:

"In reference to another mysterious topic of discussion in recent months, the reason some programs appear to 'eat' one character before warm booting is because the BDOS itself is reloaded. Let me digress for a moment.

"In CP/M 2.2, there are three sanctioned ways to perform console I/O: via 'normal' BDOS console I/O calls, via BDOS function number 6, and by calling the BIOS directly. In fact, the last two methods do exactly the same thing. I presume Digital Research was preparing us for systems like MP/M and CP/M 3, where accessing the BIOS is a definite 'no-no.'

"Normal BDOS I/O works as follows: whenever a character is sent out to the


console, a check is made for an input character being available; it is tested to see if it is a Control-S. Note that this is the only character that the BDOS is looking for at this time. If it is a Control-S, the BDOS enters a tight loop looking for the next character, which may be, for example, a Control-Q to resume output or a Control-C to warm boot. However, if the input character was not a Control-S, it is stored in a one-byte buffer in the BDOS, and the BDOS no longer performs any status checks during output. When the .COM program terminates with a RET to the CCP (as in STAT), the character is still in the BDOS's buffer, and the next BDOS input call will retrieve it first, before

calling the BIOS for more characters. If, however, the .COM program terminates with a warm boot, the BDOS is re-loaded, leaving the buffer empty; hence, one character is gone.

"This also causes an unfortunate interaction between BDOS function 6 I/O and the rest of the BDOS I/O calls. Programs should never mix 'normal' BDOS calls with function 6 or BIOS calls. Otherwise, input characters may 'vanish' mysteriously, only to reappear at a later input prompt.

"Digital Research has a stop-gap patch for the latter problem, but only for MP/M II 2.1. They have apparently taken a completely different approach in CP/M 3.

HAS CP/M® LEFT YOU IN THE DARK?



With the MRS/OS Source Code, you can see the light.

If you own a CP/M compatible operating system, you've had to put up with the mistakes and quirks of someone else's programming. Until now. Now you can see the light with MRS/OS. In fact, MRS is a full operating system designed to replace CP/M 2.2 or CDOS and it comes with complete source code. MRS is designed for Z80 processors, runs CP/M software, and can interface directly to a CP/M BIOS, saving you a lot of sysgen time.

All this for under sixty bucks.

With MRS, you get more than what you pay for. For under sixty dollars you receive fully commented source code for standard and extended BDOS functions, a sample BIOS, our all-in-one utility package and a 150 page manual.

So if you're tired of being in the dark with some other guy's program, here's the answer to your prayers.

\$59⁹⁵

complete

(includes shipping & handling in N. America; overseas add \$12)
 Mass. orders include 5% sales tax



Orders: 9 am - 10 pm EST
 Tech. inquiries: 7 pm - 10 pm EST



CP/M is a registered trademark of Digital Research Corp. CDOS is a registered trademark of Cromemco Corp.

16 Bowman Lane
 Westboro, MA 01581
 (617) 366-8969

Circle no. 46 on reader service card.

In 3, they appear to examine characters as they do in 2.2; but if it is not an appropriate control character, it is discarded. This is why type-ahead routines which worked with 2.2 will not function at the CCP level in CP/M 3.

"Here are two other tidbits that may be of interest to you.

"The CP/M 2.2 'Reset Disk System' BDOS function 13 returns a result parameter in the A register. A is 0 if no \$\$\$SUB file is active; otherwise it is nonzero. This is how the CCP knows whether or not to continue from the submit file. However, the function only looks at whether or not the first character of any filename is a dollar sign. This is why you may have noticed some strange extra disk activity

and a general sluggishness if you have, for example, a filename beginning with a '\$' in your directory. It appears that the CCP attempts to open \$\$\$SUB, fails, and then attempts to delete \$\$\$SUB.

"The CP/M 2.2 'Raw Console I/O' BDOS function 6 has an undocumented additional option. An E register argument of OFEH merely checks the status of the console, and does not return or delete any pending input characters. This is consistent with raw character handling in CP/M 3 and MP/M II."

OUT: and INP: — Making Them Work

Craig Miller also found the time to include this brief explanation and the neces-

sary assembler source code to implement the OUT: and INP: devices in PIP.COM:

"When DRI upgraded PIP for CP/M Plus, the undocumented IRD: device was dropped and is now only available in V2.2 of CP/M. I have found that the OUT: and INP: drivers are in PIP 3.0; however, the documentation doesn't describe how to install them. The enclosed listing (Listing Two, below) shows how to do this."

DDJ

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 191.

CP/M Exchange (Text begins on page 16)

Listing One

```

MVI      A,0CH      ;Turn reader on
OUT      01H
MVI      A,08H      ;Turn reader off
OUT      01H
WAIT:    IN         01H      ;Wait until reader has a character
RLC
RLC
RLC
RAR
JC        INPUT      ;If carry, then done (get char), else loop
JMP      WAIT        ;Loop back
INPUT:   IN         03H      ;Get character
ANI      07FH        ;Mask parity bit
RET

```

(End Listing One)

Listing Two

;THIS FILE WILL PATCH THE I/O ROUTINES INTO
;PIP FOR VERSIONS 2.2 AND 3.0 (INP: AND OUT:).

TRUE	EQU	OFFFHH	INPJMP	EQU	180H
FALSE	EQU	0	OUTJMP	EQU	184H
				ENDIF	
PIP22	EQU	FALSE		ORG	INPJMP
PIP30	EQU	TRUE		JMP	INPUT
	IF	PIP22			
PATCH	EQU	110H		ORG	OUTJMP
PATCHEND	EQU	1FFH		JMP	OUTPUT
INPJMP	EQU	103H			
INPCHR	EQU	109H		ORG	PATCH
OUTJMP	EQU	106H			
	ENDIF				
	IF	CPM30	DATA	EQU	84H
PATCH	EQU	188H	STAT	EQU	85H
PATCHEND	EQU	1FFH	MODE	EQU	86H

(Continued on page 20)

Don't call her cheap. Call her beautiful.

The Bonnie BlueTM

Word Processing System for the IBM Personal Computer

It's obvious what makes her so cheap, but what makes Bonnie Blue so beautiful? Bonnie Blue is a new and easy-to-use word processing program for the IBM Personal Computer.

The Full System. The Bonnie Blue System includes in one program a full screen Editor, a Printing module and a useful Toolbox. It includes the features you've come to expect, and more:

complete cursor control: by character, word, line; page up and down instantly; go to top, bottom of document; auto scroll towards top or bottom

word wrap

margin justification, centering

adjustable margins, tabs, indents

reformat paragraphs

move, copy, delete, paste blocks

find with delete, insert, replace and wild card characters

keyboard remapping

multi-line headers, footers

Bonnie Blue can handle lines longer than the screen is wide, by horizontally scrolling the line. And, unlike some programs, Bonnie Blue lets you include any displayable character in your text, such as block graphics and foreign language characters.

Unique Features. With Bonnie Blue, you can "paint" display attributes onto your text, by the character, word, or line, or automatically as you enter text. With the monochrome adapter, you can paint any combination of underlined, bold, reverse video or blinking. With an 80 column monitor and the color/graphics adapter, this translates into a palette of 16 color combinations to choose from. And if your computer has both monitors, Bonnie Blue lets you use them both, shifting back and forth as you wish.

Powerful Printing Module. You can use these colors or display attributes to highlight text on the screen, and Bonnie Blue can remove them from a file when you want (all files created by Bonnie Blue are DOS standard). The Printing module understands these text attributes, and you can map them into any single printer function or combination.

For example, normally you would want underlined text to print underlined. But you can tell Bonnie Blue to print underlined characters as both underlined and bold. Bright text on the screen can mean double struck, or emphasized and in italics. You are at the controls.

The first Print formatting module supports all the text capabilities of the Epson MX series with Grafrax Plus. By the time this ad appears, we will be supporting other popular dot-matrix and letter quality printers.

More than thirty "dot" commands give you added control of the format of your finished document. You can send it to a disk file instead of the printer, or preview the final page formatting on the screen.

Toolbox. The Toolbox is a set of useful functions, called "filters" that allow you to extract information from your files and transform their content. With these tools, you can join files together, sort lines of text, count words, find and substitute patterns, etc. Writers and programmers find this a useful collection of productivity enhancers.

Bonnie Blue is also great for a hard disk system. A thorough User's Guide, complemented by help screens and roadmaps, make the Bonnie Blue an exceptionally easy-to-learn and easy-to-use system.

Order yours today, or send for our free brochure. Bonnie Blue is available exclusively from **Bonnie Blue Software**, P.O. Box 536, Liverpool, NY 13088.

IBM Personal Computer is a trademark of IBM Corp. Epson Grafrax Plus is a trademark of Epson America Inc.

Bonnie Blue Software

Post Office Box 536
Liverpool, NY 13088

☐ Send me the Bonnie Blue System. I am enclosing \$50 (NY State residents please add 7% sales tax).

☐ Please send literature. I have a _____

☐ Check enclosed ☐ VISA ☐ MasterCard Sorry, no COD.

Credit Card No. _____ Expires _____

Signature _____

Name _____

Address _____

City _____ State _____ Zip _____

Company _____

Only \$50

Minimum

recommended system:

IBM PC, 128K, 2 disk drives,
PC-DOS 1.1 or 2.0, 80-column
monitor or monochrome adapter,
or both, Epson MX-80 or
MX-100 with Grafrax Plus.

*Versions available soon for PCjr.
Write for details.*

CP/M Exchange (Listing Continued, text begins on page 16)

Listing Two

```
COMM          EQU      87H

INIT:         MVI      A,OCEH          ;INIT 2661 TO 9600 BAUD, 8 BITS
              STA      INITFLG
              OUT      MODE
              MVI      A,03H
              OUT      MODE
              MVI      A,27H
              OUT      COMM
              IN       DATA
              IN       DATA
              MVI      C,9
              LXI      D,SIGNON        ;PRINT THE PATCHED MESSAGE
              JMP      5

INPUT:        LDA      INITFLG        ;INPUT A CHARACTER FROM DPC-100
              ORA      A
              CZ       INIT
INPLOOP:      IN       STAT
              CMA
              ANI      3
              JNZ      INPLOOP
              IN       DATA
              ANI      7FH

              IF      PIP22
              STA      INPCHR
              ENDIF
              RET

OUTPUT:       MOV      A,C            ;OUTPUT A CHARACTER
              STA      SAVCHR
              LDA      INITFLG
              ORA      A
              CZ       INIT
OUTLOOP:      IN       STAT
              ANI      1
              JZ       OUTLOOP
              LDA      SAVCHR
              OUT      DATA
              RET

SIGNON:       DB       '2661 SERIAL PORT AT 9600 BAUD',0DH,0AH,'$'
INITFLG:      DB       0
SAVCHR:       DB       0

LAST:
              IF      LAST > PATCHEND
              ERROR PATCH IS TOO LONG !!!!!!!
              ENDIF

              END
```

(End Listings)

SUBVERSIVE SOFTWARE

*So cheap and useful
it's...dangerous!*



A radical idea in software development.
Useful Pascal programs, with:

- Complete annotated source listings;
- Disk(s) with source code and compiled code;
- User manual;
- Complete programmer documentation describing data structures and algorithms; and giving suggestions for modification.

Modify them, include them in your own systems, or simply use them.

A growing library of software tools you'll find hard to resist.

SUBVERSIVE SOFTWARE

TPL

The Text Processing Language. A text-file runoff program consisting of a set of text-processing primitive commands from which more complex commands (macros) can be built (as in Logo). Features include:

- Complete customization of text processing through macro definition and expansion, looping structures, and conditional statements;
- Adapts to any printer;
- Pagination;
- Text justification and centering;
- Indexing and tables of contents;
- Superscripts and subscripts;
- Bolding and underlining;
- Multiple headers and footers;
- End notes and footnotes;
- Widow and orphan suppression;
- Floating tables and 'keeps.'

\$50

SUBVERSIVE SOFTWARE

DBX

Blocked Keyed Data Access Module. Maintains disk files of keyed data. Can be used for bibliographies, glossaries, multi-key data base construction, and many other applications.

- Variable-length keys;
- Variable-length data;
- Sequential access and rapid keyed access;
- Single disk access per operation (store, find, delete) in most cases;
- Multiple files;
- Dynamic memory allocation for RAM-resident index and current "page" of entries;
- Includes demonstration program and testbed program.

\$50

SUBVERSIVE SOFTWARE

PDMS

The Pascal Data Management System. A user-oriented data management system in which numeric and alphanumeric data are stored in tables with named columns and numbered rows. Currently being used for dozens of different kinds of business and scientific applications, from inventory management to laboratory data analysis. Includes over 20 Pascal programs; more than 10,000 lines of code. Main features include:

- Maximum of 32,767 rows per file;
- Maximum of 400 characters per row, and 40 columns per table;
- Full-screen editing of rows and columns, with scrolling, windowing, global search/replace, and other editing features;
- Sorting, copying, merging, and reducing routines;
- Mailing label program;
- Reporting program generates reports with control breaks, totals and subtotals, and selects rows by field value; many other reporting features;
- Cross-tabulation, correlations, and multiple regression;
- Video-display-handling module;
- Disk-file-handling module.

Many other features. UCSD formats only.

\$250

SUBVERSIVE SOFTWARE

ZED

Full-screen text editor; designed to be used either with TPL or by itself.

- Full cursor control;
- Insert mode with word wrap;
- 'Paint' mode;
- Single-keystroke or dual-keystroke commands;
- Command synonyms;
- Global search and replace;
- Block move, block copy, and block delete.

\$50

SUBVERSIVE SOFTWARE

SCINTILLA

A log logit curve fitting program for radio-immunologic data; must be used with PDMS (described above).

- Multiple protocol files;
- Quality control files;
- Four-parameter non-linear curve fit.

UCSD formats only.

\$250

SUBVERSIVE SOFTWARE

CHROME

Chromatography data analysis program:

- Graphic display of analog data;
- Panning and zooming;
- Automatic peak-finding and baseline calculation;
- Full interactive peak editing;
- Computation of peak areas;
- Strip charts on C. Itoh and EPSON printers.

\$100

SUBVERSIVE SOFTWARE

PLANE

Planimetry program:

- Bit-pad entry of cross sections;
- Real-time turtlegraphics display;
- Calculation of areas;
- Saves calculations to text file.

\$100

SUBVERSIVE SOFTWARE

MINT

A terminal emulation program for communication between computers of any size.

- User-configurable uploading and downloading of files;
- X-ON/X-OFF and EOB/ACK protocols;
- Interrupt-driven serial input (for Prometheus Versacard in Apple II);
- Printer-logging.

\$50

For more information, call 919-942-1411. To order, use form below or call our toll-free number: 1-800-XPASCAL

Check appropriate boxes:

FORMAT

- ☐ 8" UCSD SSSD
☐ 5 1/4" Apple Pascal
☐ 5 1/4" UCSD IBM PC 320k
☐ 8" CP/M SSSD
☐ 5 1/4" IBM MS-DOS
☐ 5 1/4" CP/M Osborne

PRODUCT

- ☐ DBX
☐ PDMS
☐ TPL
☐ ZED
☐ MINT
☐ SCINTILLA
☐ CHROME
☐ PLANE

PRICE

- ☐ \$ 50
☐ \$250
☐ \$ 50
☐ \$ 50
☐ \$ 50
☐ \$250
☐ \$100
☐ \$100

Name _____

Address _____

☐ MasterCard

☐ VISA

☐ Check

☐ C.O.D.

(Please include card # and expiration date)



SUBVERSIVE SOFTWARE

A division of Pascal & Associates,

135 East Rosemary St., Chapel Hill, NC 27514

An Introduction to Modula 2 for Pascal Programmers

If you've been following discussions about programming languages in the computer press, you have probably seen mention recently of "Modula-2, the new language by Niklaus Wirth, the father of Pascal." Articles have appeared that pit Modula-2 against Pascal and even against Ada!

What exactly is Modula-2, and how much does it differ from Pascal? How difficult would it be for an experienced Pascal programmer to learn Modula-2?

We feel that a programmer familiar with Pascal should be able to pick up the basics of Modula-2 in an afternoon and be programming comfortably within a few days. To this end, we'll briefly introduce Modula-2 from a Pascal programmer's point of view, describing similarities and differences as we go.

This will not be an introduction to the entire Modula-2 language. Parts of the language deal with direct access to the hardware and with concurrent programming. These are worth an article by themselves. The definitive description of Modula-2 may be found in Niklaus Wirth's *Programming in Modula-2*, 2nd edition (Springer-Verlag, 1983).

One warning: The following assumes some familiarity with Pascal. In particular, we will refer to what is known as Standard Pascal or ISO Pascal, which is the language standardized by the International Standards Organization (ISO), or the equivalent language standardized in the United States as ANSI/IEEE770X3. 97-1983. Most, if not all, Pascal implementations provide (incompatible) features beyond this standard, but few fail to provide the features we will mention.

The Origins of Pascal

When you hear the phrase "structured programming," chances are good that you'll think of Pascal, although you might think of PL/I, C, or even ALGOL 60 or ALGOL 68. Pascal, designed by Niklaus Wirth, appeared in the literature in about 1971. It traces its structure back to

ALGOL 60, although Wirth worked on several languages between 1960 and 1971, including ALGOL-W, EULER, and PL360.

Wirth was dissatisfied with ALGOL 68 (the new improved ALGOL), at least partly because it was incomprehensible even to its designers and it did not admit of a simple, efficient implementation on typical computers. PL/I provided a similar lesson in the costs of large languages. Pascal on the other hand, was designed with simplicity and regularity as primary goals. It is characterized by features whose implementation is well understood and efficient and whose interactions are known and manageable. It is also widely associated with the now famous (or infamous) term "strongly typed language," although it was not the first language of this kind.

The Origins of Modula-2

The roots of Modula-2 are to be found in Pascal, Modula, and Mesa. Modula (i.e., Modula-1) was an intermediate stage in the evolution to Modula-2. Mesa, a language developed at the Xerox Palo Alto Research Center (PARC), was used to program the Alto and Star computers.

In 1976, Wirth spent a sabbatical year at Xerox PARC. He was impressed by Mesa and by the fact that an entire personal computer environment (operating system, compilers, editors, etc.) could be developed using a single high-level language. He returned to the Eidgenössische Technische Hochschule (ETH) in Switzerland and designed the Lilith machine, a microcoded computer with a high-resolution bitmap display similar to the Xerox Alto. The entire software environment of the Lilith was implemented in Modula-2.

Like Pascal, Modula-2 is a relatively simple language. It contains a few simple logical control structures. It provides a number of data types, including enumerations, sets, and records, and it allows the programmer to define types. In contrast to standard Pascal, it includes a number of features that make it particularly well suited for implementing large software systems, concurrent (multiprocess or interrupt-driven) systems, and systems that require low-level access to the hardware.

Unlike Pascal, the language Modula-2 does not define a file data type or any I/O operations, such as Get, Put, Read, or Write. In a Modula-2 system, **standard modules** provide access to files and devices; these services may even be user-written. The book *Programming in Modula-2* defines several of these standard modules.

This approach is familiar to C programmers, who use a standard library to do I/O.

Because of the great effect this has on Modula-2 program portability, several companies that sell Modula-2 implementations are working together to ensure compatibility of both their language implementations and their libraries.

Modula-2 and Modularity

Many dialects of Pascal allow for what is called independent compilation. The parts of a program are compiled independently and then combined with a linker or binder. While full checking is done within each compiled unit, little or no checking is done between units. For example, the number and types of procedure parameters are not checked in a call between units; in fact, it may be possible to use a variable in one unit as a procedure in another, usually with undesirable results!

The Modula-2 language stipulates that a program may consist of compilation units (modules) that are separately *but not independently* compiled. A correct implementation of the language provides as much checking between two separately compiled modules as it provides within each module. A few Pascal implementations (notably UCSD) also provide strong checking between compiled units.

When a module needs to use objects provided by another module, such as types, constants, variables, or procedures, it **imports** them from the providing module, giving the name of the providing module and the names of the desired objects. Such a module is said to be a "client" of the providing module.

Modules that provide objects for use by other modules are divided into a **definition part** and an **implementation part**. The definition part lists the objects that are provided by the module and gives enough information about them to allow the compiler to check their use. The implementation part gives the full story, including procedure bodies and other objects that are hidden within the module.

One important thing to note is that many implementations are possible for a given definition part. The details of an implementation are not visible to other modules, so any implementation that provides the objects described in the definition part and operates in the "expected" way will do.

This is called **information hiding** and it is a very powerful way of structuring systems. Some of its power comes from

by Hugh McLarty
and David W. Smith

Hugh McLarty, Logitech, 165 University Avenue, Palo Alto, CA 94301.

David W. Smith, Tolerant Systems, Inc. 81 E. Daggett Dr., San Jose, CA 95134.

the fact that most bugs, and much of what might be called software inertia, come from assumptions (i.e., information). A bug is the symptom of an incorrect assumption; inertia is the result of a widely embedded assumption that needs to be changed. Information hiding is simply the technique of localizing information; it operates on the theory that information the programmer does not have access to cannot be abused or embedded in the code. Modula-2 modules provide an excellent mechanism for doing this.

For example, during development, simple but logically correct implementations are used. As module interfaces become settled and the needs of the system become understood, more sophisticated implementations can be substituted. Altering or replacing an implementation part does not require that we understand how the rest of the system depends upon it, only that we understand how the rest of the system depends upon the objects in the definition part. If the definition part does not change, we have some confidence that no ripple effects will spread changes (and bugs) across the system.

Consider a symbol table module, as used in a compiler to collect identifiers and their meanings. We can choose an interface and write it as a definition part then create a simple implementation part, perhaps using a linear list to store symbol entries. This is slow for more than a few symbols, but it is quick and easy to implement. Later we can substitute an implementation that uses a hash table or a binary tree, or one that swaps entries to disk when memory fills up, and so on. A well-conceived definition part will remain constant through all of this, and few if any changes to client modules will be necessary.

From Pascal to Modula-2

To begin our discussion of the differences between Modula-2 and Pascal, let's consider the short programs in Figures 1a and 1b (at right). The single-entity PROGRAM of Pascal is replaced by the MODULE of Modula-2. This module is an example of a program module. Other module types are discussed below.

First, upper and lower case are distinguished in Modula-2; in particular, keywords are all upper case. "WriteLn" is distinct from "writeln" and both are distinct from "WRITELN."

The Modula-2 program imports two objects from the InOut module; in this case the objects are procedures. When this program is compiled, the definition part for InOut will be found and used to check the calls of those procedures within this client module. InOut is a standard module, described in the book *Programming in Modula-2*.

This explicit import takes a little more effort to write but quickly tells the reader

what objects are being imported and where they come from. The only identifiers that are implicitly imported are record fields and enumeration constants.

Identifiers, Numbers, and Strings

The Pascal Standard says that identifiers may be of any length and that all characters are significant. The original (Jensen and Wirth) definition only required that the first eight characters be significant, and many systems still have a noticeable restriction, especially for iden-

tifiers known between modules. The Modula-2 definition does not say anything about identifier length, but it seems to be widely understood that identifiers are very long, i.e., 72 or 80 characters at a minimum. All characters are significant, and a too-long identifier is an error. We have already mentioned the new case distinctions.

Real numbers are just slightly different. No digits are required after the decimal point, but the decimal point is always required. For example:

```
PROGRAM TestProgram (OUTPUT);
BEGIN
    WriteLn('Hello, World');
END.
```

Figure 1a.
A simple Pascal program

```
MODULE TestProgram;
    FROM InOut IMPORT WriteString, WriteLn;
BEGIN
    WriteString("Hello, World");
    WriteLn
END TestProgram.
```

Figure 1b.
The same program in Modula-2

```
TYPE DIRECTIONS = SET OF (up, down, left, right);
VAR barriers: DIRECTIONS;
...
barriers := DIRECTIONS {up, left}
```

Figure 2.
Modula-2 set expression

```
RECORD x, y: REAL;
    CASE tag: Color OF
        red:      a: CARDINAL      (* first variant part *)
        | blue:   b: INTEGER       (* note, no ( . . ) *)
        | green:  c: BITSET
    END; (* CASE *)
    z: [0..99];
    CASE BOOLEAN OF
        TRUE:    m, n: CARDINAL
        | FALSE: p: POINTER TO CHAR
    END (* CASE *)
END; (* RECORD *)
```

Figure 3.
Modula-2 record expression

5. is OK in Modula-2 but not in Pascal.

1E-3 is OK in Pascal but not in Modula-2.

More importantly, Modula-2 provides syntax for hexadecimal and octal constants and for writing character constants using their octal ordinal values. Some examples:

hexadecimal: 0FFFFH
octal: 0177564B
character: 15C (ASCII CR)

A character string in Modula-2 is a sequence of characters surrounded by either single or double quotation marks. A string delimited by single quotes may contain double quotes, and vice versa, but there is no way to have both in the same string.

A string of length n ($n > 1$) has the type:

ARRAY [0..n-1] OF CHAR

Presently, a string of length 1 will have type CHAR. This causes some problems, since it is not compatible with any AR-

RAY OF CHAR type. Wirth has agreed to relax the compatibility rules in this case, and this change should be in the next edition of *Programming in Modula-2*.

Types and Declarations

One radical change from Pascal to Modula-2 is that Modula-2 allows any number of CONST, TYPE, VAR, and PROCEDURE sections, in any order; it is also legal to make forward references within statements (e.g., to types, constants, variables, and other procedures). There is no FORWARD construct in Modula-2.

An important new scalar type, CARDINAL, takes on nonnegative integer values up to an implementation-defined maximum, usually called MaxCard. This is intended to allow use of the unsigned arithmetic that is available on many machines, and it is expected that MaxCard > MaxInt in many implementations. Many things that involve INTEGER in Pascal are done with CARDINAL in Modula-2.

Enumerations are unchanged, but subrange types are now surrounded by [

and].

Set types are unchanged, although set expressions are slightly different. A standard set type, BITSET, is defined as

TYPE BITSET = SET OF [0..n-1]

where n is the size, in bits, of a handy unit on the target computer – typically one or two words. (BITSET is part of the language, but there is no standard constant related to n !) As for set expressions, they can contain only constant elements and ranges and must be preceded by the name of a set type unless that type is BITSET (Figure 2, page 23).

Records have a slightly different syntax and are allowed to have any number of variant parts in any position (Figure 3, page 23). Modula-2 does not support “packed” structures.

Procedures

There are two minor differences between a Pascal procedure and a Modula-2 procedure. The first is that an empty formal parameter list is allowed and, indeed, is required for a function procedure with no parameters. The second is that the name of the procedure must be repeated after the terminating END of the procedure body.

However, a revolutionary change has occurred in the way procedures can be used: In addition to the procedure parameters allowed in Pascal, Modula-2 allows variables and record fields of a procedure type. Such variables and fields can have a procedure assigned to them; the procedure can then be called by designating the variable or field, followed by an actual parameter list. We have suggested some of the possibilities of this change with the fragment of Modula-2 code in Figure 4 (at left).

In a related area, Modula-2 also addresses some of the old (Level 0) Pascal problems with array parameters. In Modula-2, a procedure such as the one in Figure 5 (page 26) is possible. The ARRAY OF construction means that, when the procedure is called, an array of any size may be passed to this parameter. Within the procedure, the array has a lower bound of 0, and the built-in function HIGH returns the appropriate upper bound.

Expressions

In dealing with Modula-2 expressions, the Pascal programmer will find few surprises. The same basic set of operators is available in Modula-2, including the set operators, with the same priorities.

The one surprise in store for expression lovers is a pleasant one. Recall that the first operand of an AND or OR operator determines whether or not it is necessary to evaluate the second operand (i.e., if the first operand of an AND is false, the result is false, and the value of the second operand is unimportant). In

```
TYPE CommandProcedure = PROCEDURE(ch: CHAR);
VAR Command: ARRAY CHAR OF CommandProcedure;
    TimeToQuit: BOOLEAN;

PROCEDURE CommandInterpreter( );
VAR ch: CHAR;
BEGIN
    TimeToQuit := FALSE;
    REPEAT
        Terminal. Read(ch);           (* get a character from key *)
        Command[ch] (ch);             (* call command routine *)
    UNTIL TimeToQuit;
END CommandInterpreter;

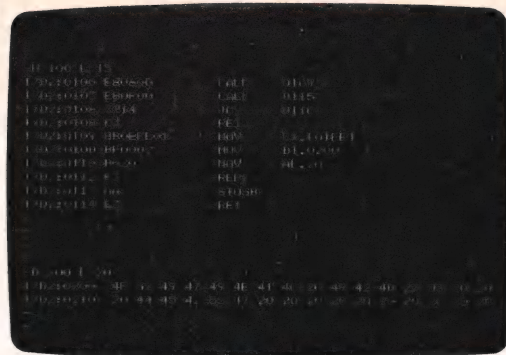
..
PROCEDURE InitializeCommandTable;
BEGIN
    FOR ch := 0C TO 177C DO
        Command[ch] := IllegalCommand
    END;
    Command["q"] := QuitCommand;
    ...
END InitializeCommandTable;

PROCEDURE IllegalCommand(ch: CHAR);
BEGIN
    Terminal. Write(ch); Terminal. Write("?");
    Terminal. WriteLn;
END IllegalCommand;

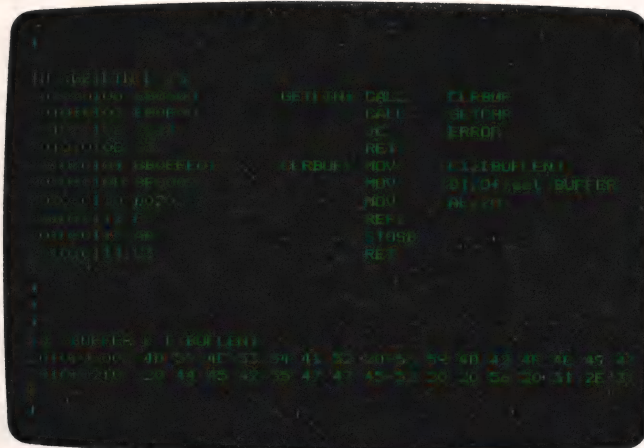
PROCEDURE QuitCommand(ch: CHAR);
BEGIN
    TimeToQuit := TRUE
END QuitCommand;
```

Figure 4.
Modula-2 code illustrating procedures

The difference



Original IBM Debug Program



Mylstar Symbolic Debugger V1.1

is Mylstar's Symbolic Debugging Program*

The plain and simple difference is that Mylstar's Symbolic Debugging Program speaks to your IBM PC in a language you both can understand, plain and simple.

Employing the same command structure, it allows you to use symbol names, mathematical expressions, batch files, on-line help, multi-command macros and other time-saving entries.

It's the enhancement to the *IBM Debug Program* you've been looking for—because it fills in the gaps—shortening the frustrating debugging process by as much as 50%—leaving you more time to do the work you need to do and the work you want to do, plain and simple.

Mylstar's Symbolic Debugging Program has been programmer-tested for over a year at Mylstar Electronics, Inc., (formerly D. Gottlieb & Co.), designers of the video arcade game, *Q*BERT*™.

TO ORDER...
Call (312) 562-7400 or mail coupon today.

*Designed for IBM PC-DOS 1.1 with 128K RAM minimum



**MYLSTAR
ELECTRONICS
INC.**

**165 West Lake Street
Northlake, Illinois 60164**

A Columbia Pictures Industries Company

**Mylstar Electronics, Inc.,
165 W. Lake St., Northlake, IL 60164**

Please send me Mylstar's Symbolic Debugging Program for use with the IBM PC computer. Enclosed is \$125, plain and simple.

☐ Check ☐ Money Order

118

NAME _____

FIRM _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

Illinois residents add 7% sales tax
Allow 2-4 weeks for delivery

this case, not evaluating the second operand is called "short circuiting" the expression, and this is exactly what Pascal did *not* promise to do – but Modula-2 does.

If you don't see how important this is, consider the problem of searching a linked list for a record with a given key, where the key may not be present in the list. In Pascal, because it is not defined whether both operands of an AND are evaluated, we must write the loop very carefully to avoid accessing through a NIL pointer (Figure 6a, below). The corresponding loop in Modula-2 is more straightforward (Figure 6b, below).

Statements

One of the first things you are likely to notice when reading a Modula-2 program is the relative scarcity of the keyword BEGIN. Most statements in Modula-2 include an explicit terminator (usually END) and act on a sequence of statements, instead of on a single statement as in Pascal (although the single Pascal statement is often a sequence of statements inside of a BEGIN/END pair).

Modula-2 supports the same basic iteration and flow control structures as Pascal, with a few additions and one notable exception: there is no GOTO in Modula-2.

As shown in Figure 7 (below), the WHILE/DO is now terminated with END, and the REPEAT/UNTIL is absolutely unchanged. (In some sense, it was the most Modula-like statement in Pascal.)

To this set of iteration constructs, Modula-2 adds LOOP (Figure 8, below). Statements within a LOOP are executed until a RETURN or EXIT statement is encountered. The EXIT statement is only legal within the scope of a LOOP and terminates the nearest enclosing LOOP.

The Pascal FOR statement survives in Modula-2 with a slight increase in power. The DOWNTO form is eliminated, and a BY clause is allowed, to specify the step on each iteration. The default step is 1, of course, and the FOR statement is terminated with a matching END (Figure 9, below).

As you might expect, the IF statement requires an explicit terminating END, which is a little tedious but eliminates the problem of matching an ELSE with the correct IF clause. (The Modula-2 ELSIF construction provides some relief from the pain of IF-END nesting.) Figure 10 (page 27) demonstrates how this can remove possible problems.

The CASE statement has undergone the most change. Most notably, an ELSE clause has been added to catch missing

values. This, of course, is present in one form or another in many Pascal implementations.

Case labels must still be constants, but ranges are allowed as well as single values. Also Modula-2 allows constant expressions where Pascal allows only a literal or constant identifier. The sequence of statements following a case label is separated from the next case label by a vertical bar (Figure 11, page 27).

Modules

The compilation unit in Modula-2 is a module. In general, as explained earlier, modules are split into two parts (a definition part and an implementation part), which are compiled independently. The definition part defines the interface that the module presents to the outside world: the "what" of the module. The implementation part (the "how") is intentionally hidden. To see how this works, consider a simple stack mechanism (Figure 12, page 27).

In addition to push and pop (the primary stack operators), the stack module exports two variables, Overflow and Underflow, through which errors are signaled. A module may export procedures, constants, types, and variables.

Note that the two variables declared

```
PROCEDURE Uppcase(VAR str: ARRAY OF CHAR);
VAR i: CARDINAL;
BEGIN
  FOR i := 0 TO HIGH(str) DO
    str[i] := CAP(str[i])
  END
END Uppcase;
```

Figure 5.
Array parameters in Modula-2

```
WHILE (column < 80) AND (Card[column] = "0") DO
  Card[column] := ' ';
  column := column + 1;
END
REPEAT
  p := p^.next;
  length := length + 1;
UNTIL p = NIL
```

Figure 7.
The Modula-2 WHILE and REPEAT constructs

```
found := FALSE
WHILE (p <> NIL) AND NOT found DO BEGIN
  IF p^.key = k THEN
    found := TRUE
  ELSE
    p := p^.next
  END;
END;
```

Figure 6a.
Linear searching in Pascal

```
WHILE (p <> NIL) AND (p^.key <> k) DO
  p := p^.next
END;
```

Figure 6b.
The same fragment in Modula-2

```
LOOP
  ReadLine( );
  IF eof EXIT;
  WriteLine( );
END
```

Figure 8.
The Modula-2 LOOP construct

```
FOR c := (Width - 1) TO Cursor BY -1 DO
  Line[c + 1] := Line[c];
END
```

Figure 9.
The Modula-2 FOR construct

in the definition part are not redeclared in the implementation part. This is because all constants, variables, and types declared in a definition part are known implicitly in the corresponding implementation part.

The third item of interest is the code at the bottom of the implementation module, where the top level of a Pascal program would be found. This code is called the module body, and it can be used to initialize the module. It is executed after the bodies of any imported modules are executed. In case of circular reference, no order is defined.

The main (top level) module of a Modula-2 program is simply a MODULE. It may (and most likely will) import definitions, but it does not export any.

How does Modula-2 ensure that the correct implementation modules are used when the program is linked? Each time a definition part is compiled, it is assigned a timestamp. When any other module is compiled that refers to that particular interface, the timestamp is included in

the compiled code. Both the implementation of the interface and the clients of the interface receive these timestamps.

When modules are linked together, all of the timestamps for each interface are compared; if they are not identical, then a warning is issued. This happens if two modules are compiled with different versions of some definition part, which means that there could be an inconsistency between the definitions of objects and their use.

This section is not a comprehensive discussion of modules. We refer the interested reader to the Modula Report (in the back of *Programming in Modula-2*), particularly for further discussion of modules and low-level programming features. David L. Parnas has written several fundamental papers on the subjects of information hiding and the use of modules in the design of software systems. Doug Cooper's book, *Standard Pascal - User Reference Manual*, is a good reference for standard Pascal.

Finis

This is by no means the complete story on Modula-2. As we mentioned, we did not discuss certain provisions for concurrent programming and for low-level systems programming at all. We hope that the Pascal programmer who was curious about Modula-2 has had some questions answered and perhaps some new ones raised.

We are particularly indebted to the DDJ reviewers whose sharp questions and knowledgeable comments made this article much better than it would have been.

Hugh McLarty is manager of the Modula-2 Software Engineering Group at Logitech, Inc. in Palo Alto. David Smith is presently with Tolerant Systems, Inc.

DDJ

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 192.

```
IF Total > 2000.0 THEN
  IF Total > 10000.0 THEN
    Total := Total + BigBonus
  ELSE
    Total := Total + SmallBonus;
```

Figure 10a.
Incorrectly indented Pascal

```
IF Total > 2000.0 THEN
  IF Total > 10000.0 THEN
    Total := Total + BigBonus
  ELSE
    Total := Total + SmallBonus
  END
END
```

Figure 10b.
The same rewritten in Modula-2

```
CASE ch OF
  ' ': Token := Blank
  '0'..'9': Token := Number
  'A'..'F', 'a'..'z': Token := Letter
ELSE Token := Unknown
END
```

Figure 11.
A Modula-2 CASE statement

```
DEFINITION MODULE IntStack;
  EXPORT Push, Pop, Overflow, Underflow;
  VAR Overflow, Underflow : BOOLEAN;
  PROCEDURE Push (Item : INTEGER);
  PROCEDURE Pop ( ) : INTEGER;
END IntStack.

IMPLEMENTATION MODULE IntStack;
  CONST StackSize = 100;
  VAR Stk : ARRAY [1..STACKSIZE] OF INTEGER;
      Top : [0..STACKSIZE];
  PROCEDURE Push (Item : INTEGER);
  BEGIN
    IF Top = StackSize THEN
      Overflow := TRUE;
    ELSE
      Top := Top + 1;
      Stk[Top] = Item;
    END
  END Push;
  PROCEDURE Pop ( ) : INTEGER;
  BEGIN
    IF Top = 0 THEN
      Underflow := TRUE;
      RETURN 0;
    ELSE
      Top = Top - 1;
      RETURN Stk[Top + 1];
    END Pop;
  BEGIN (* Initialize the stack *)
    Top := 0;
    Overflow := FALSE;
    Underflow := FALSE;
  END IntStack.
```

Figure 12.
Stack mechanism in Modula-2

Converting Fig-Forth to Forth-83

Forth has a colorful history compared to most modern computer languages. It evolved into its current form within a few years as the result of the work of one man (Charles Moore), was jealously guarded as a proprietary product for quite a few more years, and came into widespread use only after a group of volunteer systems programmers created a set of public domain implementations in 1978. The same programmers founded the Forth Interest Group (FIG) shortly thereafter.

Flushed by the success of the FIG implementations, our heroes formed the Forth Standards Team. The team was charged with creating a clear specification for the Forth language that could be used as a reference by both users and systems vendors. Ignoring the old engineering adage, "If it works, don't fix it," they produced the document known as the Forth-79 Standard, which was widely criticized and then almost as widely ignored.

Back to the drawing boards for the Forth Standards Team. Reconvening in late 1982, they began the traditionally grueling process of creating a new Standard, which involves much lobbying, arguing, and infighting. In August 1983, they took a final vote and approved the Forth-83 Standard document.

Even before Forth-83 hit the streets, it drew hostile comments from many vendors because it ignored or bypassed a number of important issues (such as reading device status and 32-bit implementations), was exceedingly vague about vocabularies (considered a vital feature of the language), and actually redefined the action of certain keywords and control structures that had been in common use for years — in essence creating a new language incompatible with all existing Forth programs.

The reader may well ask how such a Standards document could be created and approved. The politics of Forth would make a fascinating subject for a sociologist's dissertation, but I'm not sure I

understand them well enough to explain them. For the purposes of this article, let us just note that both the board of directors of FIG and the members of the Forth Standards Team are self-elected. Nearly all have been in office since the beginning of FIG, and their responsiveness and accountability to the membership of FIG (let alone the general community of Forth vendors and users) is minimal.

With all of its peculiarities, the Forth-83 Standard seems likely to come into widespread use fairly quickly. The alternative is to stick with Forth-79, which has major deficiencies, or with fig-FORTH (Forth-78), which has become very dated. Two of the largest Forth vendors (Laboratory Microsystems and Micromotion) have already committed to converting all of their systems to Forth-83 and have independently created two rather similar implementations.

A third, public domain implementation, known as F83 and written by Michael Perry and Henry Laxen, has also become available through certain user groups. It is a powerful system that includes a full screen editor, assembler, and other programming tools. Unfortunately, F83 consists of a very large and confusing body of source code that incorporates many cute Forth programming "tricks" and shortcuts. I doubt that Forth beginners will find the F83 model comprehensible.

The remainder of this article consists of a detailed guide to conversion of existing fig-FORTH software to Forth-83. The instructions assume that the target system is a Laboratory Microsystems (LMI) or Micromotion implementation, though the instructions should be applicable for the most part to any Forth-83 system. The material assumes an average level of Forth programming competence and is not directed to readers unfamiliar with the Forth language.

Conversion Overview

Due to the Forth Standard Team's lack of concern for upward compatibility with the commonly available fig-FORTH, poly-FORTH,™ or Forth-79 systems, it is quite likely that your programs will need some careful inspection and editing before they will execute properly on top of a Forth-83 Standard nucleus; we have provided a checklist of things to look for. Because this is not guaranteed to be inclusive, refer to the 83-Standard docu-

ment and the glossary section of your Forth System User Manual for more detailed information. In case of a conflict between the two, assume the 83-Standard document description to be correct.

1. Due to the runtime requirements of the redefined **LOOP**, **+LOOP**, and **LEAVE** words, the return stack is maintained in a different format than in previous implementations. In LMI Forth systems, the **LOOP** or **+LOOP** construct requires three control words on the return stack. Programs that rely on specialized knowledge of the return stack will require extensive changes and cannot, in any case, be considered "standard" or "portable."

2. All "state smart" words such as **'** (tick) and **.** (dot-quote), which previously had different actions depending on whether they were invoked inside or outside a colon definition, have been either eliminated or redefined.

3. The fig-FORTH words **CFA**, **PFA**, **LFA**, and **NFA**, which were used to find the addresses of different fields within a dictionary header, have been eliminated. A new set of words, adopted from the Kim Harris experimental proposal, has been included in the new LMI and Micromotion systems:

BODY>	LINK>
>BODY	>LINK
NAME>	N>LINK
>NAME	L>NAME

Detailed explanations will come in a later section. At present, the only word of this set that is part of the 83-Standard is **>BODY**.

4. For various reasons the definition of all divide functions (except for the unsigned divide) has been changed slightly. The general effect is that quotients are floored instead of rounded toward zero. This should cause no problems for most preexisting application software. The new divide functions are marginally slower than the old (a few machine cycles under most circumstances). The side effects of redefinition for floored divide can be counter-intuitive under some circumstances. For example, in fig-FORTH the operation

-40 360 MOD

would return the obvious answer (-40) on the stack, while Forth-83 returns 320!

by Ray Duncan

Ray Duncan, Laboratory Microsystems,
P. O. Box 10430, Marina del Rey, CA
90295.

5. The true flag returned by all logical operations has been changed from the value 1 to the value -1 (all bits set). If your code uses 0 or 1 returned by a comparison in an arithmetic operation, you will need to interpolate the operator **ABS** after the logical operator. This is a particularly difficult problem to look for in your source code. However, I feel that this mutation in the 83-Standard was beneficial as it allows the returned true/false value to be used as a mask for **AND**.

6. **PICK** and **ROLL** are now zero-based, instead of one-based. The reasoning behind this change uses the rather weak argument that programmers frequently use zero as the beginning index for loops.

7. The word **LEAVE** has become an "Immediate" compiler word with state-checking to satisfy the 83-Standard's requirements. It, in turn, compiles the runtime word (**LEAVE**). If your previous code includes compiler extensions referencing **LEAVE**, it may need modification.

In addition, the runtime action of **LEAVE** is immediate; that is, it causes a direct transfer of control past the end of the currently active innermost loop. Consequently, the new **LEAVE** is unstructured, so that a loop increment may accidentally be passed outside the loop construct under certain circumstances. This problem is easier to demonstrate than explain; observe the following (admittedly contrived) example:

```
: TEST 1000 0 DO 2 ?TERMINAL
IF LEAVE THEN +LOOP ;
```

If **?TERMINAL** returns a true flag, after exit from the **DO ... +LOOP** construct, 2 will remain on the stack in the Forth-83 system whereas it would have been discarded in fig-FORTH.

8. Certain very commonly used Forth words were not included in the Standard and their eventual fate should be regarded as uncertain: they might be standardized with a different definition or abolished altogether. The list includes:

S->D	OUT	ERROR
?TERMINAL	SCR	?ERROR
CONTEXT	DPL	MESSAGE
CURRENT	HLD	.LINE
FENCE	R#	THRU
DP	C,	-->

Restrictions on an 83-Standard Forth Application Program

Forth systems, whether complying with any Standard or not, typically contain many environmentally dependent words in addition to the Standard's required word set. In order for your application programs to be portable to any Standard Forth system, you should observe the following rules (abridged from the Standard document).



The IBM/PC
can dance—
Use C86.

OPTIMIZING C86™ controls Charlie... LIKE A PUPPET ON A STRING!

Serious programmers can use Optimizing C86 to control the IBM PC and MS-DOS computers. Features include 30% + more speed and:

- A **Full and Standard** implementation of the C language balancing tight control of the machine with productivity and portability.
- **Hardware and operating system interfaces** for: graphics, interrupt control, **8087** use, I/O ports, real time applications and for producing ROMs.
- Use of the **standard MS-DOS Linker** and a compiler option to produce **MASM** Assembler output. Helps integrate with MASM, MS FORTRAN and PASCAL.
- A **rich set of libraries** that includes source for K&R functions, extras for string handling, graphics, sorting, floating point (8087 and 8086/8088). "**Large**" model memory use (1,000K RAM), "**Small**" memory model, MS-DOS 1.1, 1.25, 2.0, 2. + + .
- Support for numerous **add-on libraries** including: **HALO Graphics**, C Tools for fundamentals in many areas, **PHACT** for **ISAM** and others. Ask for a list and for descriptions.

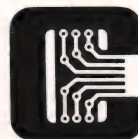
Pull Charlie's strings with our fast, complete, proven, reliable C Compiler—the leading compiler for serious programmers of MS-DOS and CPM-86 systems. Still only \$395. Call for details.

INQUIRIES AND ORDERS:

800-922-0169

Technical support: (201) 542-5920

Prices subject to change without notice.



Computer Innovations
980 Shrewsbury Avenue
Suite J-506
Tinton Falls, NJ 07724

Visa MC

C86 is a trademark of Computer Innovations, Inc. CPM-86 is a registered trademark of Digital Research. MS-DOS is a trademark of Microsoft. PC-DOS is a trademark of International Business Machines.

Circle no. 13 on reader service card.

NGS FORTH

A FAST FORTH
OPTIMIZED FOR THE IBM
PERSONAL COMPUTER
AND MSDOS COMPATIBLES.

*79 STANDARD

*FIG LOOKALIKE MODE

*PC-DOS COMPATIBLE

*ON-LINE CONFIGURABLE

*ENVIRONMENT SAVE
& LOAD

*MULTI-SEGMENTED

*EXTENDED ADDRESSING

*AUTO LOAD SCREEN BOOT

*LINE AND SCREEN EDITORS

*DECOMPILER &
DEBUGGING AIDS

*8088 ASSEMBLER

*BASIC GRAPHICS & SOUND

*NGS ENHANCEMENTS

*DETAILED MANUAL

*INEXPENSIVE UPGRADES

*NGS USER NEWSLETTER

A COMPLETE FORTH
DEVELOPMENT SYSTEM.

PRICE: \$70

PLEASE INCLUDE \$2 POSTAGE &
HANDLING WITH EACH ORDER.
CALIFORNIA RESIDENTS :
INCLUDE 6.5% SALES TAX.



NEXT GENERATION SYSTEMS
P.O.BOX 2987
SANTA CLARA, CA. 95055
(408) 241-5909

Circle no. 44 on reader service card.

1. A Standard application may reference only the definitions of the 83- Standard Required Word Set and Standard Extensions and any definitions that are subsequently defined in terms of those words.

2. A Standard program may operate only on data that was stored by the application. The initial contents of variables and arrays created at compilation time are explicitly undefined.

3. A Standard program may address:

Parameter fields of words created with **CREATE**, **VARIABLE**, and user-defined words that execute **CREATE**

Dictionary space **ALLOTTed**

Data in a valid mass storage buffer

Data area of user variables

Text Input Buffer (**TIB**) and **PAD** up to amount specified as the minimum for each area

4. A Standard program may not address:

Directly into the data or return stacks

Into a definition's name, link, or code fields

Into a definition's parameter field if its contents were not stored by the application

Although the capability of doing these types of operations is probably present in the system you are using (**SP@**, **RP@**, **>NAME**, etc.), the operations should be avoided if you intend to port your program to 83-Standard systems provided by different vendors.

Program Conversion to Forth-83

This checklist is not foolproof, but it can save you a lot of time just getting your programs to the point where they will compile (proper execution, of course, is another problem). Most of the changes indicated are related to adoption of the Forth-83 Standard; other renamings are not properly part of the Standard but have been adopted in the Laboratory Microsystems, Micromotion, or public domain Laxen/Perry models.

1. Search for all instances of **R**; replace with **R@**.

2. Search for all instances of **-DUP**; replace with **?DUP**.

3. Search for all instances of **WORD**. When it occurs as **WORD HERE**, delete the **HERE**. When **WORD** is not followed by **HERE**, replace it with **WORD DROP**.

4. Search for all instances of **PICK** and **ROLL**; replace them by **1- PICK** and **1- ROLL**, respectively.

5. Examine all **DO ... LOOPS**. For any loop that might be entered with the limit equal to the index, replace **DO** with **?DO**.

6. Search for all instances of **LEAVE**. Note that the action of **LEAVE** will be immediate. If it occurs within an **IF ...**

ELSE ... THEN clause, **LEAVE** should be the last word before the **ELSE** or **THEN**. If **LEAVE** is used within a **DO ... +LOOP** construct, make sure that the incrementing value will not remain on the stack if **LEAVE** is executed.

7. Search for all instances of **'** (tick) within a colon definition. If it is not preceded by **[COMPILE]**, replace it with **[']**.

8. Search for all instances of **."** (dot-quote) outside of a colon definition; replace the **."** with **.(** and the closing delimiter **"** with **)** to prevent compilation failures.

9. Search for all instances of **NFA**, **PFA**, **LFA**, and **CFA**. It is best to examine these and recode them individually, but you can make some "brute force" substitutions as follows:

<i>This:</i>	<i>Becomes:</i>
'	' >BODY (outside colon definition)
' CFA	' (outside colon definition)
' CFA	['] (inside colon definition)
NFA	BODY> >NAME
' NFA	' >NAME
LFA	BODY> >LINK
' LFA	' >LINK
PFA	NAME> >BODY
PFA CFA	NAME>

Bear in mind that the old definitions had the following actions:

CFA	(pfa --- cfa)
NFA	(pfa --- nfa)
LFA	(pfa --- lfa)
PFA	(nfa --- pfa)

These were predicated on the fact that **'** returned the parameter field address. Since **'** and **[']** now return the code field address, the new words suggested by Kim Harris revolve around that value:

>BODY	(cfa --- pfa)
>LINK	(cfa --- lfa)
>NAME	(cfa --- nfa)
BODY>	(pfa --- cfa)
LINK>	(lfa --- cfa)
NAME>	(nfa --- cfa)

These are appealing and symmetric, but before you get too carried away with them remember that a Standard program can't access any part of a dictionary definition except for the parameter field ("body"). Two additional words are provided for convenience in traversing the linked dictionary list:

N>LINK	(nfa --- lfa)
L>NAME	(lfa --- nfa)

10. Search for all instances of **ENDIF** and replace with **THEN**.

11. Search for all instances of **MINUS** or **DMINUS** and replace with **NEGATE** or **DNEGATE**, respectively.

12. Search for all instances of **SIGN** and

fix up stack logic. Usually **SIGN** can be replaced by **ROT SIGN**.

13. Any use of **-FIND** must be recoded individually. You can usually replace it with the sequence **BL WORD FIND**.

14. Search for all instances of **?** and replace with **@..**

15. Search for all instances of **BLANKS**; replace with **BLANK**.

16. Use of old **CREATE** words in your programs must be modified. In most instances on LMI implementations, you can replace it with the new word **BUILD**. The Forth-83 word **CREATE** has a much different effect.

17. Search for all instances of the construct **<BUILDS...DOES>** and replace with **CREATE...DOES**.

18. Search for all instances of **END** and replace with **UNTIL**.

19. Search for all instances of **(NUMBER)** and replace with **CONVERT**.

20. Search for all instances of **IN** and replace with **>IN**.

21. Search for all instances of **FLUSH** and replace with **SAVE-BUFFERS**.

22. Search for all instances of **U*** and replace with **UM***; similarly, replace all occurrences of **U/** with **UM/**.

23. Replace all instances of **S->D** with **S>D**.

24. Replace the word **SP!** with the sequence **S0 @ SP!**, and change the word **RP!** to **R0 @ RP!**.

25. Search for all instances of **TIB @** and replace with **TIB**. Recode any sequences of **TIB!** in an implementation-dependent manner.

26. Difficult to find by inspection but very dangerous is the use of the Boolean flag returned by a comparison in a calculation, such as the sequence **0= ADD**. These must be recoded individually.

27. Also difficult to find is the use of specialized knowledge of the return stack (such as fetching the index of the third outer loop). These must be individually examined and recoded.

28. Search for all **VARIABLE** declarations and delete leading initializing value (these do no harm but will be left as residual data on the stack at the end of compilation). Although most implementations do set the initial value of a variable to zero or -1, a Standard application program is, of course, not allowed to take advantage of this information. It is most correct to initialize variables at runtime (so that the code is reusable); however, your old fig-FORTH compile-time initialization of variables can easily be mimicked. For example, the fig-FORTH statement

4 VARIABLE XVAR

would be changed to

VARIABLE XVAR 4 XVAR !

29. Search for all instances of **+ -** and **D+ -**; replace them with **?NEGATE** and **?DNEGATE**, respectively.

30. Examine occurrences of **MOD**. If either argument can take on a negative value, the results may surprise you.

31. Find all **M/MOD** and replace with **MU/MOD**. Search for all instances of **M/**; replace with **M/MOD**.

References

Forth-83 Standard. A publication of the Forth Standards Team. Available for \$15.00 from Laboratory Microsystems Inc., P. O. Box 10430, Marina del Rey, California 90295.

FORTH TOOLS, Volume 1. By Anita Anderson and Martin Tracy. A new tutorial on Forth; all example programs are written in Forth-83. Available for \$20.00 from Micromotion, 12077 Wilshire Blvd. #506, Los Angeles, California 90025.

"Signed Integer Division." By Robert L. Smith. *Dr. Dobb's Journal*, September 1983, page 86.

"When a Page Is Not a Page: Forth-83 and Vocabularies." By George William Shaw II. *Dr. Dobb's Journal*, September 1983, p. 90.

DDJ

(A Summary of Vocabulary Changes begins on page 32)

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 193.

SAVE YOUR 8 BIT SYSTEM WITH THE ONLY TRUE 16 BIT CO-PROCESSOR THAT HAS A FUTURE



DO NOT BUY INTO OBSOLESCENCE LET HSC "STEP" YOUR 8 BIT SYSTEM INTO THE 16 BIT REVOLUTION THROUGH EVOLUTION.

- Easily attaches to ANY Z80 based microcomputer system. Successful installations include: Xerox I&II, Osborn I, DEC VT180, Zenith, Heath, Bigboard, Ithaca, Lobo, Magic, Compupro, Cromemco, Teletex, Altos 8000, Lanier EZ1, Zorba, Morrow, Kaypro, Televideo, etc.
- Dynamically upgrades a CPM-80 system to process under CP/M-86, MS-DOS (2.11), and CP/M-68K with no programming effort. (CCP/M-86 (3.1) and UNIX will be available soon).
- All 16 bit operating systems can use the un-used portion of C0-16 memory as RAM DISK.
- TRUE 16 BIT PROCESSOR SELECTION - 8086 (field upgradable to 80186), 80186, and 68000 (all 6mhz with no wait states - 16 bit data path). Which spells much higher performance than 8088.
- Available in a self contained attractive Desktop Enclosure (with a power supply), or in PC Card form for inclusion in 8 bit system. YOU DON'T HAVE TO CRAM IT INTO YOUR BOX ! IF YOU DON'T WANT TO.
- Does not disturb the present 8 bit operating environment.
- Memory expansion from 256K to 768K RAM.
- Optional 8087 Math Co-Processor on the 8086, and up to FOUR (4) National 16081s on the 68000!!!
- MS-DOS and CP/M may co-share common data storage devices (such as hard disk).

- * MS-DOS Compatible
- * IBM PC "Hardware" Compatible
- * CP/M-86 Compatible
- * CCP/M-86 Compatible
- * CP/M-68K Compatible

- Direct MS-DOS and PC-DOS formatted 5 1/4" Diskette read/write capability available on: Osborn I, Morrow, Kaypro, Televideo 803, and Epson QX-10 systems, More coming.
- All 768K can be used as high speed CP/M-80 RAM DISK.
- Optional Real Time Clock, DMA, I/O Bus, and 2 Serial Ports.
- I/O MODULE CONTAINING AN IBM COMPATIBLE BUS (4 slot) & an IBM COMPATIBLE KEYBOARD INTERFACE is an available option. THIS IS THE REAL DIFFERENCE BETWEEN MS-DOS and IBM PC "HARDWARE" COMPATIBILITY.

AFFORDABLE PRICES

C01686 - includes 8086, 256K RAM, Memory Expansion Bus, Z80 Interface, MS-DOS (2.11), MS-DOS RAM Disk, CPM-80 RAM Disk. \$650.00

C01686X - includes all of C01686 PLUS Real Time Clock, I/O Bus Interface, Two (2) Serial Ports, DMA, and the provision for 8087. \$795.00

C01668 - includes 68000, 256K RAM, Memory Expansion Bus, Z80 Interface, CP/M-68K, C Compiler, CPM-68K RAM Disk, CPM-80 RAM Disk \$799.00

C01668X - includes all of C01668 PLUS Real Time Clock, I/O Bus Interface, DMA, Two (2) Serial Ports, and the provision for up to four (4) 16081 Math Co-Processors. \$995.00

OPTIONS

Desktop Enclosure w/ power supply	\$125.00
Memory Expansion - 256K	\$467.00
Memory Expansion - 512K	\$659.00
I/O Module - IBM Compatible 4 slot (multiple I/O Modules allowed)	\$499.00
Math Co-Processor 8087	Call
Math Co-Processor 16081	Call
CPM-86	\$150.00

For more information:
see your favorite Dealer or contact:
HSC, INC.
262 East Main Street
Frankfort, NY 13340
1-315-895-7426
Reseller, and OEM inquiries invited.

Circle no. 29 on reader service card.

Summary of Vocabulary Changes in Forth-83

#TIB	A new 83-Standard user variable containing the length in bytes of the valid input stream within the terminal input buffer. This is <i>not</i> the length of the buffer itself. #TIB is set by QUERY after calling EXPECT . "Tick" is no longer "immediate" and returns the CFA of the target name instead of the PFA as in previous versions. Outside a colon definition, your previous code 'CFA should be replaced by ' while inside a colon definition it should be replaced by ['].	<CMOVE	Renamed to CMOVE> in 83-Standard Forth.
(FIND)	Deleted. To perform the function of the old (FIND) , use the new word FIND , which is 83-Standard.	>BODY	Converts code field address to parameter field address.
+LOOP	Termination has been redefined to occur when the INDEX crosses the boundary between LIMIT-1 and LIMIT . This is implemented in LMI Forth by adjusting LIMIT to 8000H and checking for a machine overflow flag after incrementing the INDEX . This +LOOP is faster than in the previous version but behaves somewhat differently. For example: 1 1 DO ... 1 +LOOP will execute 65,536 times (in fig-FORTH or Forth-79, it would have executed only once) while 1 1 DO ... -1 +LOOP will execute once. See also LOOP .	>LINK	Converts code field address to link field address. Not 83-Standard.
+-	Renamed to ?NEGATE as suggested by Laxen.	>NAME	Converts code field address to name field address. Not 83-Standard.
+ORIGIN	Deleted.	?	Deleted.
-DUP	Renamed to ?DUP .	?DNEGATE	New name for D+- as suggested by Laxen. Not 83-Standard.
-FIND	Essentially replaced by the 83-Standard word sequence BL WORD FIND .	?DO	Works like DO except executes zero times if the input INDEX and LIMIT are equal. A word suggested by Laxen/Harris/Perry. Not 83-Standard, but present in LMI and Micro-motion systems.
."	"Dot-quote" now may be used inside of colon definitions only. See .(also.	?DUP	Same as old -DUP .
.(New word. Immediate. The characters up to but not including the delimiting) are displayed on the standard output device (usually the operator's console). May be used inside or outside of a colon definition.	?NEGATE	New name for +- as suggested by Laxen. Not 83-Standard.
.NAME	Performs the function of the old ID.	ABORT"	A new word that requires a flag on top of stack; it does nothing if the flag is false and prints a string and executes ABORT if the flag is true. Used like ?ERROR but with no requirement for a disk access.
<BUILDS	Replaced by CREATE , which has some slightly different effects.	AGAIN	Still present in LMI Forth systems with function unchanged, but not present in the 83-Standard or even in the Controlled Reference Word Set. Probably fated for extinction, so its use should be avoided in new code. Can be replaced by 0 UNTIL .
		BLANK	Renamed from BLANKS . See below.
		BLANKS	Renamed to BLANK (not an 83-Standard word, but included in the Controlled Reference Word Set).
		BODY>	Converts parameter field address to code field address. Works like the old word CFA . Not 83-Standard.
		CFA	Removed. See BODY> , NAME> , and LINK> .
		CMOVE>	Previously known as <CMOVE .
		CONVERT	Essentially works like the old fig-FORTH word (NUMBER) . Caution: converts positive double numbers only. Sign handling must be done outside.
		CREATE	Redefined from fig-FORTH. Now used with DOES> in the same manner as the old <BUILDS .

(Continued on page 34)

Z80 Software

SOFTWARE DESCRIPTIONS

TPM (TPM I) - \$80 A Z80 only operating system which is capable of running CP/M programs. Includes many features not found in CP/M such as independent disk directory partitioning for up to 255 user partitions, space, time and version commands, date and time, create FCB, chain program, direct disk I/O, abbreviated commands and more! Available for North Star (either single or double density), TRS-80 Model I (offset 4200H) or II, Versafloppy I, or Tarbell I.

TPM-II - \$125 An expanded version of TPM which is fully CP/M 2.2 compatible but still retains the extra features our customers have come to depend on. This version is super FAST. Extended density capability allows over 600K per side on an 8" disk. Available preconfigured for Versafloppy II (8" or 5"), Epson QX-10, Osborne II or TRS-80 Model II.

CONFIGURATOR I

This package provides all the necessary programs for customizing TPM for a floppy controller which we do not support. We suggest ordering this on single density (8SD).

Includes: TPM-II (\$125), Sample PIOS (BIOS) SOURCE (\$FREE), MACRO II (\$100), LINKER (\$80), DEBUG I (\$80), QED (\$150), ZEDIT (\$50), TOP I (\$80), BASIC I (\$50) and BASIC II (\$100)

\$815 Value

NOW \$250

CONFIGURATOR II

Includes: TPM-II (\$125), Sample PIOS (BIOS) SOURCE (\$FREE), MACRO II (\$100), MACRO III (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), QSAL (\$200), QED (\$150), ZTEL (\$80), TOP II (\$100), BUSINESS BASIC (\$200) and MODEM SOURCE (\$40) and DISASSEMBLER (\$80)

\$1485 Value

NOW \$400

MODEL I PROGRAMMER

This package is only for the TRS-80 Model I. Note: These are the ONLY CDL programs available for the Model I. It includes: TPM I (\$80), BUSINESS BASIC (\$200), MACRO I (\$80), DEBUG I (\$80), ZDDT (\$40), ZTEL (\$80), TOP I (\$80) and MODEM (\$40)

\$680 Value

NOW \$175

MODEL II PROGRAMMER

This package is only for the TRS-80 Model II. It includes: TPM-II (\$125), BUSINESS BASIC (\$200), MACRO II (\$100), MACRO III (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), QED (\$150), ZTEL (\$80), TOP II (\$100), ZDDT (\$40), ZAPPLE SOURCE (\$80), MODEM (\$40), MODEM SOURCE (\$40) and DISASSEMBLER (\$80)

\$1445 Value

NOW \$375

BASIC I - \$50, a 12K+ basic interpreter with 7 digit precision.

BASIC II - \$100, A 12 digit precision version of Basic I.

BUSINESS BASIC - \$200, A full disk extended basic with random or sequential disk file handling and 12 digit precision (even for TRIG functions). Also includes PRIVACY command to protect source code, fixed and variable record lengths, simultaneous access to multiple disk files, global editing, and more!

ACCOUNTING PACKAGE - \$300, Written in Business Basic. Includes General Ledger, Accounts Receivable/Payable, and Payroll. Set up for Hazeltine 1500 terminal. Minor modifications needed for other terminals. Provided in unprotected source form.

MACRO I - \$80, A Z80/8080 assembler which uses CDL/TDL mnemonics. Handles MACROS and generates relocatable code. Includes 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical ops, local and global symbols, linkable module generation, and more!

MACRO II - \$100, An improved version of Macro I with expanded linking capabilities and more listing options. Also internal code has been greatly improved for faster more reliable operation.

MACRO III - \$150, An enhanced version of Macro II. Internal buffers have been increased to achieve a significant improvement in speed of assembly. Additional features include line numbers, cross reference, compressed PRN files, form feeds, page parity, additional pseudo-ops, internal setting of time and date, and expanded assembly-time data entry

DEVELOPER I

Includes: MACRO I (\$80), DEBUG I (\$80), ZEDIT (\$50), TOP I (\$80), BASIC I (\$50) and BASIC II (\$100)

\$440 Value

NOW \$150

DEVELOPER II

Includes: MACRO II (\$100), MACRO III (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), BUSINESS BASIC (\$200), QED (\$150), TOP II (\$100), ZDDT (\$40), ZAPPLE SOURCE (\$80), MODEM SOURCE (\$40), ZTEL (\$80), and DISASSEMBLER (\$80).

\$1280 Value

NOW \$350

DEVELOPER III

Includes: QSAL (\$200), QED (\$150), BUSINESS BASIC (\$200), ZTEL (\$80) and TOP II (\$100)

\$730 Value

NOW \$300

COMBO

Includes: DEVELOPER II (\$1280), ACCOUNTING PACKAGE (\$300), QSAL (\$200) and 6502X (\$150)

\$1930 Value

NOW \$500

LINKER - \$80, A linking loader for handling the linkable modules created by the above assemblers.

DEBUG I - \$80, A tool for debugging Z80 or 8080 code. Disassembles to CDL/TDL mnemonics compatible with above assemblers. Traces code even through ROM. Commands include Calculate, Display, Examine, Fill, Goto, List, Mode, Open File, Put, Set Wait, Trace, and Search.

DEBUG II - \$100, A superset of Debug I. Adds Instruction Interpreter, Radix change, Set Trap/Conditional display, Trace options, and Zap FCB.

6502X - \$150, A 6502 cross assembler. Runs on the Z80 but assembles 6502 instructions into 6502 object code! Similar features as our Macro assemblers.

QSAL - \$200, A SUPER FAST Z80 assembler. Up to 10 times faster than conventional assemblers. Directly generates code into memory in one pass but also to offset for execution in its own memory space. Pascal like structures: repeat...until, if...then...else, while...do, begin...end, case...of. Multiple statements per line, special register handling expressions, long symbol names, auto and modular assembly, and more! This one uses ZILOG Mnemonics.

QED - \$150, A screen editor which is both FAST and easy to learn. Commands include block delete, copy, and move to a named file or within text, repeat previous command, change, locate, find at start of line, and numerous cursor and window movement functions. Works with any CRT having clear screen, addressable cursor, clear to end of line, clear to end of screen, and 80X24.

DISK FORMATS

When ordering software specify which disk format you would like.

CODE	DESCRIPTION
8SD	8" IBM 3740 Single Density (128 bytes/26 sectors/77 tracks)
8DD	8" Double Density (256 bytes/26 sectors/77 tracks)
8XD	8" CDL Extended Density (1024 bytes/8 sectors/77 tracks - 616K)
5SD	5.25" Single Density (TRS80 Model I, Versafloppy I, Tarbell I)
5EP	5.25" Epson Double Density
5PC	5.25" IBM PC Double Density
5XE	5.25" Xerox 820 Single Density
5OS	5.25" Osborne Single Density
5ZA	5.25" Z80 Apple (Softcard compatible)

TPM INFO

When ordering TPM I or II, in addition to Disk Format, please specify one of the following codes:

CODE	DESCRIPTION
TPM I:	
NSSD/H	North Star Single Density for Horizon I/O
NSSD/Z	North Star Single Density for Zapple I/O
NSSD/H	North Star Double Density for Horizon I/O
NSSD/Z	North Star Double Density for Zapple I/O
TRS80-I	TRS-80 Model I (4200H Offset)
TRS80-II	TRS-80 Model II
VI8	Versafloppy I 8"
VI5	Versafloppy I 5.25"
TPM-II:	
VI8	Versafloppy II 8" (XD)
VI5	Versafloppy II 5.25"
TRS80-II	TRS-80 Model II (XD)

Prices and Specifications subject to change without notice.
TPM, Z80, CP/M, TRS80 are trademarks of CDL, Zilog, DRI and Tandy respectively.

ZTEL - \$80, An extensive text editing language and editor modelled after DEC's TECO.

ZEDIT - \$50, A mini text editor. Character/line oriented. Works well with hardcopy terminals and is easy to use. Includes macro command capability.

TOP I - \$80, A Text Output Processor for formatting manuals, documents, etc. Interprets commands which are entered into the text by an editor. Commands include justify, page number, heading, subheading, centering, and more.

TOP II - \$100, A superset of TOP I. Adds: embedded control characters in the file, page at a time printing, selected portion printing, include/merge files, form feed/CRLF option for paging, instant start up, and final page ejection.

ZDDT - \$40, This is the disk version of our famous Zapple monitor. It will also load hex and relocatable files.

ZAPPLE SOURCE - \$80, This is the source to the SMB ROM version of our famous Zapple monitor. It can be used to create your own custom version or as an example of the features of our assemblers. Must be assembled using one of our assemblers.

MODEM - A communication program for file transfer between systems or using a system as a terminal. Based on the user group version but modified to work with our SMB board or TRS-80 Models I or II. You must specify which version you want.

MODEM SOURCE - \$40, For making your own custom version. Requires one of our Macro Assemblers.

DISASSEMBLER - \$80, Does bulk disassembly of object files creating source files which can be assembled by one of our assemblers.

HARDWARE

S-100 - **SMB II Bare Board \$50**, "System Monitor Board" for S-100 systems. 2 serial ports, 2 parallel ports, cassette interface, 4K memory (ROM, 2708 EPROM, 2114 RAM), and power on jump. When used with Zapple ROM below, it makes putting a S-100 system together a snap.

Zapple ROM \$35, Properly initializes SMB I/II hardware, provides a powerful debug monitor.

IBM PC - **Big Blue Z80 board \$595**, Add Z80 capability to your IBM Personal Computer. Runs CP/M programs but does not require CP/M or TPM. Complete with Z80 CPU, 64K add on memory, serial port, parallel port, time and date clock with battery backup, hard disk interface, and software to attach to PC DOS and transfer programs. Mfr'd by OCS.

50% Discount on all CDL software ordered at the same time as a Big Blue (and for the Big Blue).

APPLE II - **Chairman Z80 \$345**, Add Z80 capability to your Apple II/II+ computer. Runs CP/M programs with our more powerful TPM. Includes 64K memory add on (unlike the competition this is also useable by the 6502/DOS as well as the Z80), TPM, QSAL assembler, QED Screen Editor, and Business Basic. Mfr'd by AMT Research.

Apple Special \$175, Buy the Apple Z80 Developer at the same time as the "Chairman" and pay only \$175 instead of \$325.

APPLE Z80 DEVELOPER

Includes: 6502X (\$150), MACRO II (\$100), MACRO III (\$150), QSAL (\$200), QED (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), ZDDT (\$40) and BUSINESS BASIC (\$200)

VALUE: \$1250

NOW \$325

\$175 when purchased with AMT "Chairman" Board

ORDERING INFORMATION:

VISA/MasterCard/C.O.D.

Call or Write With Ordering

Information....



OEMS:

Many CDL products are available for licensing to OEM's. Write to Carl Galletti with your requirements.

Dealer Inquiries Invited.

For Phone Orders ONLY Call Toll Free...

1-(800) 458-3491

(Except Pa.)

Ask For Extension #15

For information and Tech Queries call

(609) 599-2146

Computer Design Labs

342 Columbus Avenue/Trenton, NJ 08629

Circle no. 11 on reader service card.



(Continued from page 32)

D+-	Renamed to ?DNEGATE as suggested by Laxen.
DIGIT	Returns a true flag of -1 instead of 1 as in previous version. This is not an 83-Standard word.
DMINUS	Renamed to DNEGATE in 83-Standard systems.
DNEGATE	83-Standard word, previously called DMINUS .
DOES>	Functionally similar to before, but implementation is considerably different and involves a mixture of machine code and high-level code in the defining word's parameter field.
EMPTY-BUFFERS	Marks all disk block buffers as unassigned. Does <i>not</i> write blocks marked for UPDATE to the disk. Not an 83-Standard word but still present in LMI Forth systems. See also SAVE-BUFFERS and FLUSH .
END	Removed. Use UNTIL .
ENDIF	Removed. Use THEN .
EXPECT	Works about the same but leaves the actual length of the input in the system variable SPAN .
FIND	New word that essentially provides the capabilities of the old -FIND and "state-smart tick."
FLUSH	Writes all UPDATED blocks to disk then unassigns all block buffers. See also EMPTY-BUFFERS , SAVE-BUFFERS .
ID.	Renamed to .NAME . Not 83-Standard.
IN	Renamed to >IN .
LEAVE	Causes an immediate transfer of control to the code just beyond the next LOOP word. For example, in the code: DO ... IF XXX ELSE LEAVE YYY THEN LOOP if the ELSE path is taken, the word YYY will never be executed (unlike fig-FORTH or Forth-79).
>NAME	Converts link field address to name field address. Not 83-Standard.
LINK>	Converts link field address to code field address. Not 83-Standard.
LITERAL	Compilation only. The actual run-time word compiled may depend on the magnitude of the literal value.
LOAD	Loading from screen 0 is now defined to be illegal.

LOOP

M*

M/

MINUS

MOVE

N>LINK

NAME>

NEGATE

NFA

NOT

PAD

PICK

R@

R

ROLL

RP!

Termination has been redefined to occur when the **INDEX** crosses the boundary between **LIMIT-1** and **LIMIT**. This is implemented in LMI Forth by adjusting **LIMIT** to 8000H and checking for a machine overflow flag after incrementing the **INDEX**. This **LOOP** is faster than in the previous version but behaves somewhat differently. For example:

1 1 DO ... LOOP

will execute 65,536 times (in fig-FORTH or Forth-79, it would have executed only once).

No longer present in 83-Standard or Controlled Reference Word Set. Still present in LMI Forth systems, but use should probably be avoided.

Renamed to **M/MOD**. This is different than the **M/MOD** that was present in fig-FORTH (which function is now carried out by **MU/MOD** in some implementations).

Renamed to **NEGATE** in 83-Standard systems.

This word is listed in the Uncontrolled Reference Word Set of the 83-Standard with a different action than was common in fig-FORTH. Avoid it.

Converts name field address to link field address. Not 83-Standard.

Converts name field address to code field address. Not 83-Standard.

83-Standard word, previously named **MINUS**.

Removed. See **>NAME**.

Returns 1's complement.

Now provides a work area of at least 84 bytes.

The argument to **PICK** is now zero-based (was previously one-based). Examples: **0 PICK** is equivalent to **DUP** and **1 PICK** is equivalent to **OVER**.

New name for fig-FORTH **R**.

Renamed to **R@** in 83-Standard.

The argument to **ROLL** is now zero-based, instead of one-based. Examples: **0 ROLL** is a null operation, **1 ROLL** is equivalent to **SWAP**, **2 ROLL** is equivalent to **ROT**, etc.

Takes its argument from the top of the data stack rather than **R0**. A change suggested by Laxen/Perry for symmetry with **RP@**. The word **RP!**

S->D	in your previous code should be replaced with the sequence R0 @ RP! . Not 83-Standard.	UM*	New name for U* .
SAVE-BUFFERS	Renamed to S>D as suggested by Laxen. Not 83-Standard.	UM/MOD	New name for U/ .
SIGN	All buffers marked as UPDATED are written to the disk but remain assigned. See also EMPTY-BUFFERS and FLUSH .	VARIABLE	Does not accept an initializing value.
SP!	Definition changed: takes its argument from the top of stack rather than the third item on the stack. The word SIGN in your old code can be replaced by ROT SIGN .	VLIST	Renamed to WORDS (suggestion of Laxen).
SPAN	Takes its argument from the top of stack rather than S0 . A change suggested by Laxen/Harris/Perry for symmetry with SP@ . The word SP! in your previous code should be replaced with S0 @ SP! . Not 83-Standard.	VOCABULARY	The 83-Standard, in an attempt to remedy the 79-Standard's restrictiveness on vocabulary structures, left most details to the imagination of the Forth implementor. A radically different experimental proposal was offered by Bill Ragsdale and printed as an appendix to the Standards document, but this proposal was not approved as part of the Standard proper and has not been adopted by all Forth vendors at this point. Beware!
STATE	(LMI implementations) Displays the current search order and the names of all declared vocabularies in the system. Not 83-Standard.	VOCs	No longer present in LMI implementations. The full name (up to 31 characters) is always used.
TIB	A new system variable that contains the length of the last input via EXPECT .	WIDTH	Defined slightly changed from fig-FORTH. Returns the address of the first byte of the token it scanned off the input stream. A token may be up to 255 bytes in length.
U*	System variable. In LMI Forth systems, the value of STATE is -1 if compiling, 0 otherwise. An 83-Standard application shouldn't modify this variable.	WORD	Displays the names of the definitions in the vocabulary that is first in the current search order. Similar to old VLIST command. Not 83-Standard.
U/	Definition changed. Formerly returned the address of the location containing the address of the terminal input buffer. Now returns the actual address of the buffer. In your existing code, replace all sequences TIB @ by the word TIB alone.	WORDS	Used inside a colon definition to compile the CFA of the following word, like the old "state-smart tick" word. See also ' and FIND .

(End Table)



THE 488+3 IEEE 488 TO S-100 INTERFACE

IEEE-488



S-100

- Handles all IEEE-488 1975/78 functions
- IEEE 696 (S-100) compatible
- MBASIC subroutines supplied; no BIOS mods required
- 3 parallel ports (8255A-5)
- Industrial quality; burned in and tested
- \$375

(Dealer inquiries invited)

D&W DIGITAL

20655 Hathaway Ave.
Hayward, CA 94541 415/ 887-5711

Circle no. 24 on reader service card.



Sixth Generation Computers

Dr. Dobb's periodically prints material designed to provoke thought on topics which look toward the future. In December 1982, we published an essay by Richard Grigonis entitled "Fifth-Generation Computers," which sketched a picture of microcomputer technology in the 1990s. Michael Doherty challenged his predictions (*Open Forum*, March 1983), requesting more substantial discussion. Grigonis' lengthy response in the August 1983 DDJ discussed topics ranging from silicon theory to sociology. Now Grigonis has provided us with more food for thought. Doherty, having seen an advance copy of the piece, has already written a reply, which we will publish next month. — Editor

The favorable response to my last article, "And Still More Fifth Generation Computers" (DDJ No. 82), has encouraged me to write another article on future hardware that picks up where the last one left off, taking speculation about future computers to the limits that can be conceived of by the human mind. So, without further ado, let us complete our journey into the future....

Physical Limitations

All artificial intelligence programs must represent knowledge and the logical connections between such knowledge, the total possible combinations of these being the search space or all possible final states or solutions. A tree structure is usually the most convenient way of describing the possible final states, with each successor node representing a possible state that can be derived from the initial state via the appropriate operators.

The search for a desired goal, such as the best move in a chess game, thus consists of searching each successor node of the tree (graph) to discover a node with a state description satisfying the goal; the path to that node is the appropriate operator sequence that yields the best final state.

Blind search or "exhaustive search" algorithms (such as the breadth-first

search) never fail to uncover the best solution since they examine every node or possible state. Unfortunately, many problems have a search space that is either infinite (such as logic) or else so large (such as chess) that the computational cost makes such exhaustive searches impossible. The fact that one must examine all sequences of n moves immediately implies a search space where the number of nodes grows exponentially with n , so if at each move the player has K choices, then n moves comprise K^n possible move sequences. The possible final states grow exponentially with n and so result in a combinatorial explosion that overflows the computer's memory and requires eons of processing time. The algorithm for playing a perfect game of chess is not beyond the capabilities of a theoretical universal Turing machine, but it is certainly beyond its physical embodiment, the digital computer.

Developing artificial intelligence thus became a matter of devising short-cuts, or forms of heuristic search, so that information about the nature of the problem domain allows the program to "prune the search tree" and run more efficiently. Some of these heuristic searches include the Minimax and Alpha-Beta pruning procedures. Still, the danger with pruning the search tree via short-cuts (heuristics) is that, while some of these heuristics do guarantee success by improving efficiency, others do not even guarantee a solution at all! This is particularly troublesome when one is dealing with yes-no questions, as opposed to those questions requiring a value (with a tolerable margin of error) as an answer. The greater the number of heuristics, the more like a human being the program will behave, and the greater the chance that the program will miss the best solution. Human beings use heuristics a good deal more than they do precise algorithmic techniques, and the certainty of their decisions suffers accordingly. Only an exhaustive search of the available possibilities can give a perfect solution, but the computational cost of performing these searches is tremendous.

Therefore, many mathematical, logical, and artificial intelligence problems can never be solved because the computational requirements of algorithms that perform better than the heuristic capabilities of humans exceed the ability of any existing or projected computer. Even an optical computer utilizing matrix processing techniques will probably never ex-

ceed 1.5 trillion operations per second; this signal flow falls far short of even Hans J. Bremermann's relatively small theoretical limit of 1.35×10^{47} bits per second per gram of system weight. Searching through a search space requires computations, and computations require time and energy. Since computational devices are bound by both limits here in the physical world, as Bremermann says, "the accessible portion of the mathematical universe is limited."

Or is it? Memory is not the problem it used to be. The new Cray and Fujitsu supercomputers can each be equipped with 256 megabytes of internal memory, and the Japanese Fifth Generation computer will have 1000 megabytes or about a billion bytes (gigabyte) of memory. Sometime in the first half of the next century, supercomputers will have at their disposal about 64 gigabytes of memory. It is the processing time required for a solution to many of these algorithms that seems to be the real problem. In the case of chess alone, with over 10^{120} moves (I think Shannon's estimate of this is wrong, as the real figure probably exceeds 10^{150} moves), a huge number of computation-years are required to exhaustively search the possible moves.

The two solutions to this problem have been either to develop distributed array processing (reducing a problem to its components and having a different processor work on each part of the problem) or to simply build faster processors with smaller or newer non-von Neumann architectures. Neither of these ideas has turned out to be quite as successful as was initially thought. After all, even if every atom in our galaxy were replaced with a Cray-1 supercomputer, it would still take centuries to search through all the possible chess move sequences! Data flow devices have not demonstrated very many advantages over conventional computers (indeed it is impossible for them to implement simple loops or recursion), and faster and faster processors designed along the von Neumann architecture (even ignoring the problems posed by the so-called "von Neumann bottleneck") must be constructed smaller and smaller until they literally disappear.

We must conclude then that even the much-touted Japanese fifth generation computer is doomed to fail in the artificial intelligence and predicate logic theorem resolution tasks envisioned by its sponsors.

by Richard Grigonis

Richard Grigonis, Children's Television Workshop, One Lincoln Plaza, New York, NY 10023.

All drawings by Doug Kirby

Superluminal Processors?

A novel solution, which everyone seems to have missed, is to devise a processor whose signals are not bound by the speed barrier imposed by the special theory of relativity — in other words, to build a computer where the processor signals can travel faster than light. This sounds impossible, but in fact we may achieve this in three ways:

- (1) Tachyons
- (2) The application of the Einstein-Podolsky-Rosen (EPR) effect
- (3) The so-called “advanced potentials” solution of the moving charge equations derived from Maxwell’s electromagnetic theory

Let us now examine each of these three possibilities in detail and see what we can come up with.

Tachyons

Although ordinary particles with finite, real rest masses and energies cannot travel faster than electromagnetic radiation with respect to any frame of reference, particles having imaginary quantities of energy and momentum can indeed travel faster than light. These hypothetical particles were named *tachyons*, from the Greek *tachys*, meaning “swift.”

In 1962 three American physicists O. Bilanuik, V. Deshpande, and E. C. G. Sudarshan at the University of Rochester mathematically demonstrated that tachyons could have *real* energy and momentum if the particles possessed an *imaginary* rest mass instead of a real one. The value for the rest mass is imaginary in that it is the square root of a negative number.

But another problem was related to the faster-than-light (or “superluminal”) velocities of such hypothetical particles. Since anything traveling faster than light should, from our frame of reference, travel backwards in time as well, an observer watching a tachyon being exchanged between two atoms (say, between atom A and B) would see a tachyon particle of *negative* energy absorbed by atom B *before* it is emitted by A. Two things are wrong here. First, particles of negative energy are not allowed; second, the tachyon violates causality by traveling faster than light and so appears to reach atom B before it is emitted by atom A!

These theoretical obstacles to the existence of tachyons were eliminated by Columbia University physicist Gerald Feinberg and the “reinterpretation principle” he devised in 1967. An observer in the correct frame of reference (a high relativistic velocity) would not see a negative-energy tachyon being absorbed by atom

B before it is emitted by A. Since emitting a negative amount of energy is equivalent to absorbing a positive amount, the observer instead would see *atom B emit a positive-energy tachyon*, which is then absorbed by atom A. The problems of both negative energy and time-reversal vanish.

Because they have an imaginary rest mass, as tachyons lose energy they speed up instead of slowing down! Tachyons therefore would be difficult to control. Whereas an ordinary particle is stationary when at rest and requires the application of an infinite amount of vector forces (energy) to attain the speed of light, a tachyon is subject to the opposite principle: it travels at infinite velocity when at rest, and subjecting it to an infinite amount of propulsive force would merely slow it down to the speed of light!

The speed of light, then, is a “barrier” between our universe and the universe of tachyons. Interestingly, the time-axis of the tachyons’ world lines (as described by a classical Minkowski space-time diagram) is *perpendicular* to the time-axis of the particles in our own universe, so that once an observer arrives in a tachyon universe, the tachyons would appear to behave like normal particles — but the particles in our universe, by comparison, would now appear to be tachyons! That, of course, is definitely another story.

In any case, for a tachyonic computer to function, it is necessary for the tachyon signals to interact with ordinary matter at some point — namely, by triggering the processor’s binary switches.

If we assume that a tachyon can carry an electrical charge, we can create tachyons by bombarding atoms with high-energy photons in the form of, say, gamma rays. This then liberates pairs of tachyons, the resulting particles having equal and opposite charges. This electrical charge on the tachyon, because it is traveling at superluminal speed, emits a special form of electromagnetic radiation called Cerenkov radiation. This type of radiation, first fully described by the Russian physicist Pavel A. Cerenkov in 1937, is the cone-shaped shock wave of photons emitted by a particle traveling faster than light in a medium (not a vacuum, obviously, since ordinary particles do not travel faster than light); it is sort of a light version of the “sonic boom.” (Cerenkov radiation, when generated by particles whirling around in a cyclotron, looks bluish white, but, strangely enough, a prism does not separate this light into a spectrum.) A tachyon accelerates to infinite velocity within a distance of only 0.001 centimeter, as the particle quickly divests itself of its electrical charge by liberating a Cerenkov radiation cone with a 90-degree opening.

A distance of 0.001 centimeter is too small for the construction of a super-

TACHYON ACCELERATING TO INFINITE VELOCITY BY RADIATING AWAY ELECTRIC CHARGE AS A CERENKOV LIGHT CONE.

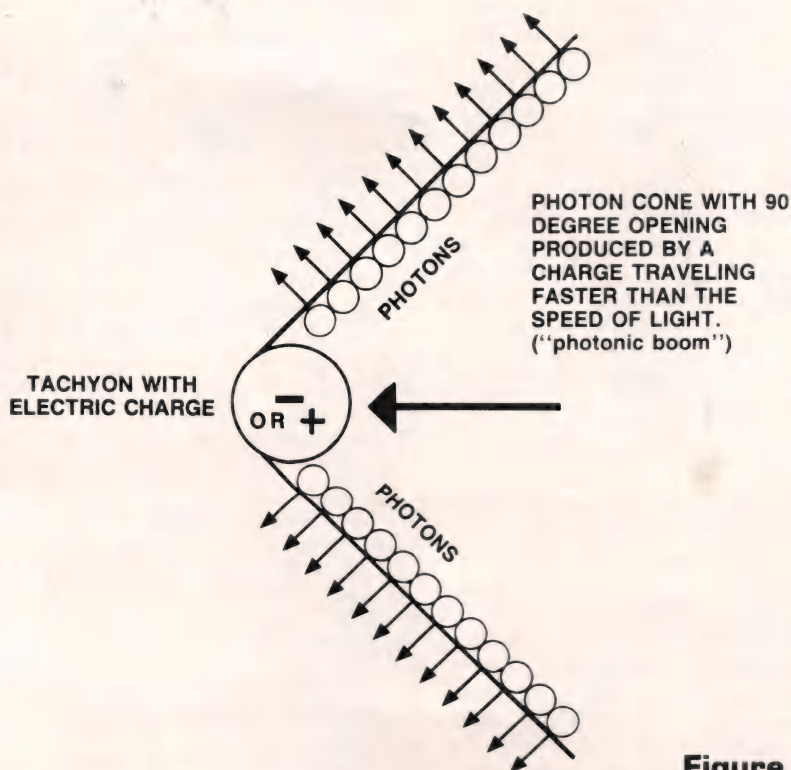


Figure 1.

luminal processor switch, but a solution exists. The tachyons can be "refreshed," or given an electrical charge again, by placing an electric field in their trajectory. Once recharged in this way, the tachyons again divest themselves of their newly acquired energy via Cerenkov radiation, which can now be detected by a photo-multiplier tube.

Therefore, each switch of a tachyonic computer would consist of a powerful electromagnetic source to generate the tachyons and an electrical field/photo-multiplier tube combination to detect tachyonic signals coming from other switches. Since we have no way of transmitting tachyons in a particular direction, all of the switches would have to broadcast and receive signals only at certain timed intervals — in a sort of packet-switching arrangement.

Another problem is that an experiment by T. Alvager and M. N. Kriesler at Princeton in 1968, using a gamma ray source (radioactive cesium) and an electric field/light detector apparatus, did *not* detect the transmission of any tachyons! However, if high-energy tachyons merely decay into several faster and more stable tachyons, this would have accounted for the Princeton experimental results.

If tachyons are passed from one atom nucleus to another in straight lines, then disturbing one end of an object would cause a tachyonic pulse to pop out of the other end instantly. We may have here the solution to the directional transmission problem. Perhaps future computers will be partly mechanical, with the switches disturbing in some way the ends of rods, each rod composed of a highly compressed substance like metallic hydrogen (although, come to think of it, *any* substance will turn into a metal if subjected to sufficient pressure); the computer would transmit faster-than-light tachyonic pulses through a network of these rods.

Ironically, in the 1940s and 1950s, certain parts of computer processors ran so quickly in comparison to the rest of the equipment that the signals had to be slowed down at certain points by converting the signals from electrical pulses moving through wires to waves moving through troughs filled with a liquid. The Americans used mercury for this purpose, while Alan Turing thought that gin had the right density.

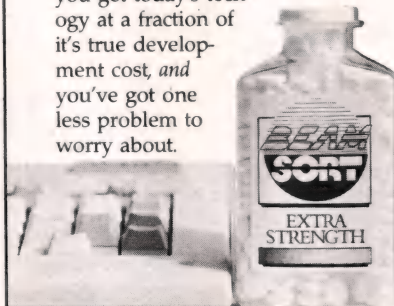
The EPR Effect

Einstein never liked the indeterministic, probabilistic view of the world posited by quantum mechanics. Einstein's own theories of relativity — the other half of modern physics — are actually the last of the great classical theories; their equations specify that space, time, and mass are a precise, calculable function of velocity,

It's a headache, of sorts.

Whether your mailing list, accounting package, DBMS, or other end-user application is currently under development or already on the market, you've probably discovered that external sorting can be a difficult, costly, and time-consuming headache. Especially in today's floppy-disk storage environment.

That's why we developed BEAMSORT™, the revolutionary *in-place* OEM sorting module. The older algorithms eat up valuable space on your user's often over-crowded diskettes. By installing BEAMSORT™ you get today's technology at a fraction of its true development cost, and you've got one less problem to worry about.



*CPM, MS-DOS, dBase II, and SuperSort are trademarks of Digital Research, Microsoft, Ashton-Tate, and Micropro, respectively.

BEAMSORT™ runs under CP/M-80*, CP/M-86*, MS-DOS*, and PC-DOS, supports multiple-volume files, ASCII, Microsoft .RAN, and dBASE II* .DBF file formats, and interfaces to all major languages. Custom interfacing, operating environments, and file formats are available.

What about performance? BEAMSORT™ runs SuperSort*'s own benchmark faster than SuperSort* does! It's amazing, but don't take our word for it. Write us on your company letterhead for our OEM evaluation kit. You must see this for yourself!

For fast relief.



Phlexible Data Systems, Inc.

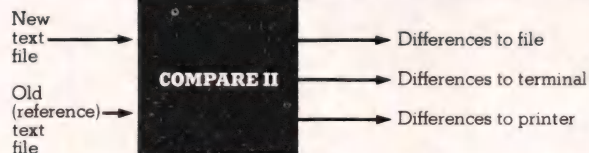
3017 Bateman Street, Berkeley, CA 94705
(415) 540-7181

Circle no. 51 on reader service card.

No more lost edit changes!

COMPARE II

High performance differential text analyzer!



Writers! Researchers! Lawyers! Engineers! Programmers!
Use highly rated COMPARE II. Cut text analysis from hours to minutes!

- ▶ PC-DOS, CP/M-86 or CP/M 2.2
- ▶ Scans by word or by line
- ▶ Fast New Algorithm, No file restrictions
- ▶ You can customize for word processor, printer width, file defaults, specific work flow, computer languages, different highlighting techniques
- ▶ Clear commands, Numerous formatting options
- ▶ Can generate new document with change bars

Specify When Ordering: Operating System, Computer Type and Disk Format. Free brochure and *nearly* free demo disk available.

COMPARE II

Demo Disk (credits to purchase) \$12.95

\$145.00

SOLUTION TECHNOLOGY, INC.

"We Deliver Productivity"

1499 Palmetto Park Road
Suite 218
Boca Raton, FL 33432
305/368-6228

PC-DOS and CP/M are trademarks of IBM and Digital Research respectively.

Check or COD, Florida residents add 5% sales tax. Dealer and Distributor inquiries welcome.

Circle no. 71 on reader service card.

and that the effect of being at rest in a gravitational field is the equivalent to being at rest in an accelerated coordinate system. Quantum physics, on the other hand, is dominated by two things that disturbed Einstein: the Schrödinger wave equation and the Heisenberg uncertainty principle.

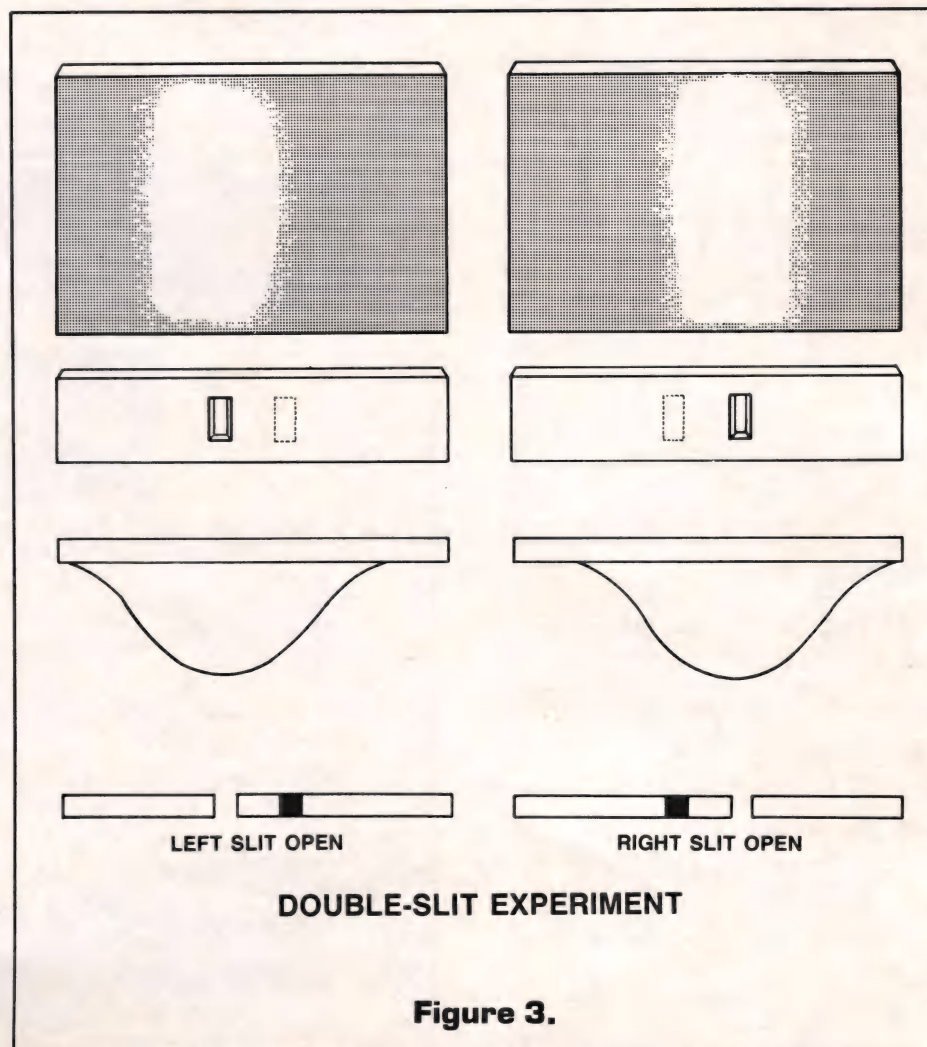
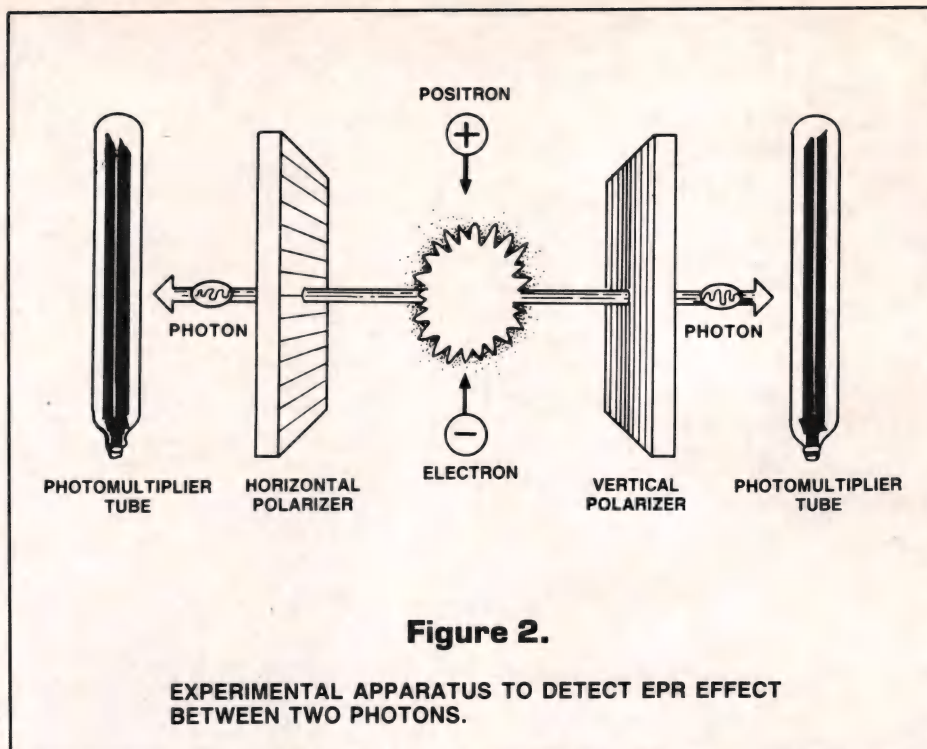
To illustrate these two bizarre items, we reintroduce an old high school physics experiment. Most of us may remember that in 1803 Thomas Young demonstrated the wave nature of light by directing sunlight through a card or metal plate with two vertical slits in it. The diffracted light, when projected upon a wall or screen, yields an interference pattern with alternating bands of light and darkness, the brightest band at the center. With only one slit open, however, diffraction still takes place, but the light forms a single fuzzy vertical patch on the screen, corresponding to the single slit through which it has just passed.

Since not only photons but all subatomic particles have a wave aspect as well as a particle aspect, we can run the double slit experiment again, this time using electrons. Instead of an ordinary screen, however, we need one coated with a phosphor to make the electron impacts visible as tiny flashes of light (turning the apparatus into a sort of CRT); a cloud chamber would also suffice.

When a single photon is diffracted through one slit, we cannot determine exactly where on the screen the particle will land. According to the Heisenberg uncertainty principle, we can know either the momentum of a particle with accuracy or the particle's position with accuracy, but we can never determine both values with high accuracy! Since we know the momentum of a photon (traveling at light velocity), we therefore cannot determine its position — until it hits the screen.

The Schrödinger Wave Equation

But if we cannot determine the photon's precise position until it hits the screen, then can we at least determine the chances of it hitting any particular area of the screen? Yes. This is where the Schrödinger wave equation comes into play, which is simply a partial differential equation that allows one to compute, given the initial state of a system, all of the probable final states of the system. In our case, this would be all of the possible positions on the screen the photon could hit at any particular time. Instead of regarding the present state of the universe as being determined by the past and in turn determining the future (the classical view), the Schrödinger wave equation gives us a "wave function" of many possible future and past states. Thus, the future state of a physical system (until the particle finally



hits) is a superposition of *all* possible outcomes.

An infinite number of states of varying probability can represent possible solutions to the Schrödinger wave equation for any physical system, depending upon the measurement. Each state is a solution to the wave equation and a possible future state (possible impact point). So, the particle can be anywhere in the cosmos before it is observed by its impact! After all, the photon or electron may have missed the screen entirely and is now far away, but this is a small probability. It is important to note that the system is not in *one* of these states, but it is probabilistically in *all* of the states until the measurement occurs; the representation of the "ensemble" of states is known as the *state vector*, or the "statistical ensemble" of states.

So imagine an electron or photon diffracted through a single slit, and imagine its wave function spread out over a huge area that includes the screen. What is so irritating about all this is that, for all practical purposes and indeed for *all* purposes, the "particle" does not exist as such until it is measured by an observer. At the moment of measurement — which is the moment when the particle hits the screen — all of the possible states disappear, the system undergoes a discontinuous change, and we find the system to be in one particular state, one given by the position on the screen of the particle's impact. The act of measurement is thus said to "collapse" the state vector onto one of the possible states given by the Schrödinger wave equation. This is also called the "reduction of the wave packet." Strangely, the particular state (position on the screen) the system settles on is determined only by pure chance.

So, although the particle is probabilistically "everywhere" (to the point where if both slits are open it can appear to pass through both slits simultaneously and interfere with itself like a wave), it is also "nowhere" in that it doesn't exist until we measure it! What is even more disturbing is that, since the wave function covers a huge area that only includes the screen, we suddenly realize that the collapse of the state vector occurs instantaneously, or much faster than the maximum speed (light velocity) allowed for by the special theory of relativity! Things like this used to drive Einstein right up the wall, leading him to say at one point that "God does not play dice with the universe."

Einstein's "Paradox" Isn't

Because Einstein could not find any inconsistency in quantum mechanics, he decided instead to prove that quantum theory was an incomplete theory. He thought he had achieved this after he cleverly concocted a "thought experi-

ment" with two of his colleagues, Boris Podolsky and Nathan Rosen, in 1935. Unfortunately for Einstein, this particular "thought experiment" ultimately backfired, proving him wrong and quantum mechanics right. The idea is now known as the EPR (for Einstein, Podolsky, and Rosen) effect, or the EPR paradox.

There are many ways of illustrating the paradox. For example, let's bump two electrons together and create a two-particle system of zero spin, which means that the spin of one electron always cancels out the spin of the other. For the moment we will not measure the electrons to determine which way they are spinning. Next, let us separate the electrons by several light years, leaving one of them in our laboratory. After doing this we measure the spin of "our" electron, thus collapsing the state vector. Theoretically, the

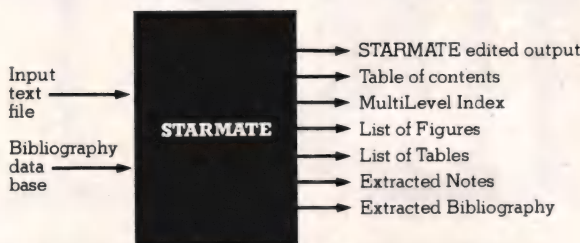
other electron doesn't exist until we measure it too. But we already know that both electrons make up a single two-particle system of zero spin, and the total spin is *always* going to be zero. So, even though the other electron is light years away, we already know what the value of its spin is by measuring the spin of the electron here on earth! The situation becomes even more bizarre when we remember that the other electron's spin is always going to be opposite to the spin of the one in the lab, so if we could alter the spin of the electron here on earth we would also *instantaneously* change the spin of the faraway particle!

Kind of scary, eh? Well, it's only scary if an experiment demonstrates it to be true. Einstein's argument was that such a thing would never happen, because a light signal could not travel fast enough to con-

Get more than WordIndex for less \$!

STARMATE

Users get high speed document finishing for WordStar with STARMATE under PC-DOS, CP/M-86, or CP/M 2.2.



Writers! Researchers! Engineers! Cut document makeup time from hours to minutes!

- ▶ Multi-Level Table of Contents
- ▶ Multi-Level Index
- ▶ Lists of Tables and Figures
- ▶ Numbers Paragraphs (1.2, 1.3, etc)
- ▶ Prepares Footnotes
- ▶ Prepares Bibliography
- ▶ Clear commands, Numerous formatting options
- ▶ Reads documents with nested files

Specify When Ordering: Operating System, Computer Type and Disk Format. Free brochure and *nearly* free demo disk available.

STARMATE

(Special Introductory Price)

Demo All Disk (credits to purchase)

\$145.00

\$12.95

SOLUTION TECHNOLOGY, INC.

"We Deliver Productivity"

1499 Palmetto Park Road
Suite 218
Boca Raton, FL 33432
305/368-6228

WordStar, PC-DOS and CP/M are trademarks of
MicroPro, IBM and Digital Research respectively

Check or COD, Florida residents add 5% sales tax.
Dealer and Distributor inquiries welcome.

Circle no. 72 on reader service card.

nect the two particles. Einstein reasoned that quantum theory must be incomplete because it allows such faster-than-light (superluminal) connections between two particles, a phenomenon that must be impossible, violating as it does Einstein's own special theory of relativity.

Einstein believed in the principle of local causes — what we measure or do to one electron's spin here on earth (let us call it position S_1) cannot possibly affect the other electron's spin in deep space (let us call it position S_2) unless we allow sufficient time for some kind of signal traveling at the speed of light to reach it and impart the information to the particle. As Einstein wrote: "One can escape from this conclusion [of the incompleteness of quantum mechanics] only by either assuming that the measurement of S_1 'telepathically' changes the real situation of S_2 or by denying independent real situations as such to things which are spatially separated from each other. Both alternatives appear to me entirely unacceptable."

Amazingly, Einstein and his colleagues were proved wrong! *There are no local causes.*

Bell's Theorem

In 1964, a physicist named J. S. Bell at the European Organization for Nuclear Research (CERN) in Switzerland developed a mathematical proof that was subsequently strengthened by others and is now known as Bell's Theorem. With it, Bell theoretically demolished the principle of local causes. In 1969, J. F. Clauser, M. A. Horner, Abner Shimony, and R. A. Holt showed how physical experiments could be performed to test for faster-than-light (or "superluminal") connections or "correlations" between particles. The first of these tests was made in 1972 by Clauser with S. J. Freedman.

The scientists electrically excited neon atoms so that, when the atoms' electrons fell back to a lower, more stable energy state, they emitted pairs of photons moving in opposite directions. The wave motion of photons can be plane polarized (vertical or horizontal) or circularly polarized (clockwise or counterclockwise), so that the plane of the wave displacement rotates as they move through space. Since these photons have a common origin, they can be considered as a two-particle system. If one of the two photons is vertically

polarized, the other one is also vertically polarized. If one photon is horizontally polarized, then so is the other one. Therefore, if we measure the polarization state of one photon, we also know the value of the polarization state of the other photon, even though we have not measured it and it is far enough away so that the "information" must be traveling faster than light.

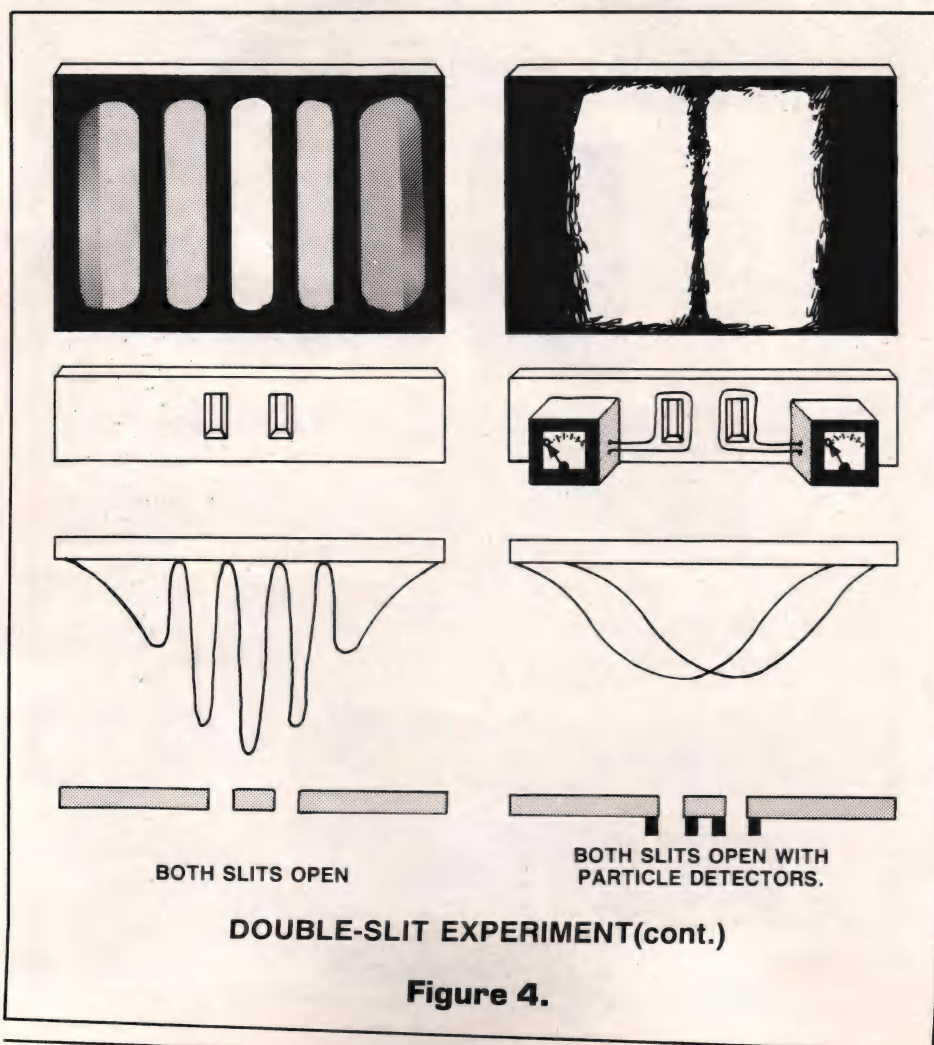
The Clauser-Freedman experiment did just that by placing polarized filters on either side of the light source. Photons passing through these polarizers then encountered photomultiplier tubes. When both polarizers were vertically oriented, the vertically vibrating photons passed through and set off both photomultipliers simultaneously. When one of the polarizers was rotated at 90 degrees to the other, however, one set of photons was stopped and the photomultipliers did not fire together.

Another way of generating pairs of photons is to bring an electron and a positron (antimatter electron) into contact, causing their annihilation. In the case of photons produced by matter-antimatter annihilation, quantum mechanics predicts that the two photons will have opposite polarization. In this case, then, the photomultipliers will fire together only if both polarizing sheets are set 90 degrees to each other. And it works again!

The most recent experiment along these lines (the eighth since 1972, I believe) was performed by Alain Aspect, Philippe Grangier, and Gerard Roger at the University of Paris. These experiments seem to prove once and for all that there are no local causes. This implies that a system can never be described in isolation, since all of the particles of matter in the universe interacted with each other long ago during the Big Bang and must therefore be "correlated" or connected.

Transmission Problems

Does all of this mean that we can build optical computers that operate faster than the speed of light? By changing an individual electron's spin or a photon's polarization, it would be quite simple to transmit messages faster than light. Quantum mechanics, however, discourages manipulating individual particles once they are measured; this violates the essential indeterminism upon which quantum theory is based. Nevertheless, while it is true that an individual photon's polarization cannot be altered once it is measured, it is also true that we decide what we are going to be looking for in the first place. Although quantum mechanics forbids individual particles to be causally tampered with, we could manipulate the variable values of a statistically large number of such particles, monitored at whatever



remote locations we wish. What immediately comes to mind is separating and altering the spin of a stream of electrons with Stern-Gerlach devices, as suggested by Gary Zukav.

Other Superluminal Phenomena

Actually, we have already encountered many kinds of faster-than-light phenomena in the double-slit experiment. First, by simply measuring the system, we have seen the wave function instantly collapse at faster than the speed of light. However, another strange phenomenon occurs that the average high school student misses when working with the apparatus. The moment an observer covers up one of the slits, preventing one set of photons or electrons from passing through it, the interference pattern consisting of light and dark bands disappears and is replaced by the single fuzzy band indicative of photons or electrons diffracted through a single slit. Now, at the moment that the observer covers up the slit, how do the other particles that are passing through the other slit "know" that there is now only one slit and that it is now permissible to go into what would have been the dark bands on the screen were both slits open, thus giving us the single fuzzy band characteristic of a single slit?

The problem is accentuated further when we fire one photon or electron at a time through the slits, slowly generating the single fuzzy band or the interference pattern on the screen, depending upon whether one or two slits are open. In this case the photon or electron not only knows what the other particles are doing, but it also knows what the physical configuration of the apparatus is! How does a single particle know if one or two slits are open?

Indeed, things become even more disturbing when one realizes that, since the spacing between the light and dark bands on the screen is determined by the distance between the slits, the particle's behavior also depends upon how far it was from a slit it didn't go through! Does the particle actually (because of its probabilistic wavelike properties) "divide" into two parts and "wave" through the two slits, interfering with itself?

To find out, let's run the experiment again with electrons, but this time try to outwit each particle and pin down exactly which slit (or slits) it goes through by building a particle detector. This is done by placing a loop of wire around each slit. A particle in motion carrying an electrical charge (the electron) generates a magnetic field; when these lines of force cut through the loop of wire (through a photon exchange between electron and wire), it generates an electrical pulse as the particle passes through the slit. We can record this

pulse. By firing one electron at a time at the apparatus, we find that each time an electron hits the phosphor-coated screen, only one particle detector will register — never both. By measuring the electron at the slit we have eliminated its probabilistic location in space and have collapsed the state vector to a particular position, which is the particular slit it has passed through. But there is more! With both slits open in this experiment, the interference pattern of multiple bands has vanished. Instead we find a pattern of *two* vertical fuzzy bands, side by side, each one resembling the pattern produced by a single slit.

What happened? Consider the uncertainty principle. By measuring the position of the electron immediately (at the slit), we force the particle to interact with the apparatus by sending a photon (the exchange particle of electromagnetism) to the loop of wire. But when a photon interacts with an electron, its momentum (mass times velocity, Planck's constant divided by the wavelength) changes by an unknown amount. This is the essence of the uncertainty principle and the price we pay for knowing the electron's position. Even worse, the value for the momentum of each electron is totally different from that of any other electron, as their positions are detected in turn.

Because we have destroyed the electron's probabilistic location in space by measuring it at a particular position (one slit or the other), the electron no longer behaves as a wave and so cannot "wave" through both slits. Instead it behaves more like a particle, the interference pattern of many light and dark bands disappears, and we see the patterns of two "single" slits side-by-side on the screen. When we do not know which slit each electron passes through, the interference pattern reappears! Sneaky particles, eh?

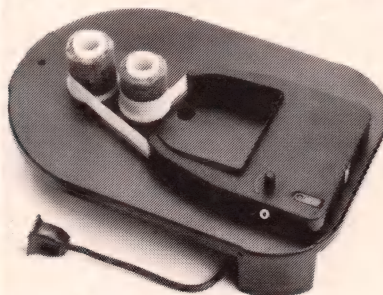
Interestingly, if we use an "unreliable" detector, one that merely tells us that there is a probability of, say, 0.7 that an electron went through a particular slit, we will find that the interference pattern only partly disappears — the multiple bands are made a bit fuzzy — and upon this is superimposed, also a bit fuzzy, the two-single-slit pattern!

Backward Causation?

One could resolve all of these strange phenomena (and eliminate the idea of an actual signal traveling faster than light) by assuming that the "direction of causality" might be violated when we measure something. In other words, instead of regarding the initial state of the system as deter-

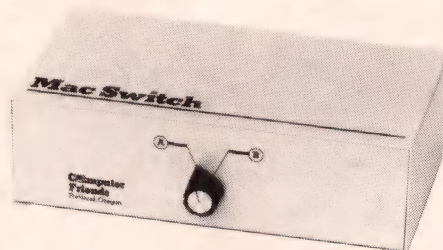
Re-ink any fabric ribbon for less than 5¢. Extremely simple operation. We have a **MAC INKER** for any printer. Lubricant ink safe for dot matrix printheads. Multi-colored inks, uninked cartridges available. Ask for brochure. Thousands of satisfied customers.

\$54⁹⁵ +



Mac Switch lets you share your computer with any two peripherals (serial or parallel). Ideal for word processors—never type an address twice. Ask us for brochure with tips on how to share two peripherals with **MAC SWITCH**. Total satisfaction or full refund.

\$99⁰⁰



Order Toll Free 1-800-547-3303

Computer Friends
6415 SW Canyon Court
Suite #10
Portland, Oregon 97225
(503) 297-2321

Mac Inker & MacSwitch

Circle no. 12 on reader service card.

mining the outcome of measurements made on it, we might regard the outcome of the measurements as determining the initial state!

As long ago as 1947, Costa de Beauregard thought that the quantum information about electron spin or photon polarization (of the EPR paradox) travels backward in time from the measured particle to the event that produced the two particles, then forward in time to the other particle. The information thus appears at the second particle just as we measure it at the first particle!

More recently, John A. Wheeler, the brilliant physicist who coined the term "black hole" some years ago, has devised a thought experiment (called the "delayed-choice, double-slit experiment") that suggests that quantum mechanics seems to allow — indeed to demand — that backward causation is real. Essentially, it consists of the same version of the experiment that used the "electron detector," except this time we are working with photons. A timed photon goes through the plate with the two slits. Beyond the two slits are two different types of optical measuring equipment.

One piece of equipment can measure the photon as a *wave*. It doesn't determine which slit the photon goes through, thereby allowing the photon to move prob-

abilistically as a wave through both slits and to interfere with itself; this "causes" the photon to strike only those areas of the screen corresponding to the bright bands of the interference pattern (areas of constructive interference), thus triggering this wave detector. The other device can measure the photon as a *particle*, by detecting through which slit the photon passes.

Nothing appears new in this experiment thus far; it just sounds like the previous experiment with the electrons and the loops of wire. But before continuing, it should be noted that, although photons (and other particles) appear to have the properties of both particles and waves, they never display both properties simultaneously. When we are measuring position, we find a particle, and when we are measuring momentum, we find a wave. We cannot measure for both properties at the same time.

Now, says Wheeler, because we can't use both pieces of detection equipment together, we have to decide whether we want to measure the photon as a wave or as a particle. But according to quantum mechanics, says Wheeler, we can decide whether the photon is a particle (goes through one slit) or a wave (probabilistically travels through both slits) *after* the photon has already gone through the plate

having the slits! Particles are correlated in space *and* time. Not only do our measurements reach across space faster than light and "determine" the state of particles that we have not yet measured, but they can reach backwards in time to "justify" the present results! As Wheeler has said, "... a choice in the present can alter in an irretrievable way what we are entitled to say about the past."

Advanced Potentials

Our discussion of superluminal phenomena signalling backwards in time should actually come as no surprise; nothing in relativity theory, quantum mechanics, electrodynamics, or mechanics says that time must move in one direction. Still, we humans seem to perceive "time's arrow" in certain "obviously irreversible" processes, such as wave motion asymmetry: an electromagnetic wave (such as a radio wave) expands from the transmitting source into infinity, never to return. This typical electromagnetic phenomenon is mathematically described in a solution to the moving charge equations (derived from James Clerk Maxwell's well-known electromagnetic field equations) as $(t + r/v)$, where t is time, r is the distance of the field from a moving charge, and v is the phase velocity. This is known as the *retarded* potential solution. The resultant type of wave motion is called retarded wave motion, since the electromagnetic fluctuation can be detected at a point in space distant from the origin after a period of time.

But as is the case with homogeneous differential equations (like the one P.A.M. Dirac discovered that defined the existence of both electrons *and* their time-reversed counterparts, positrons), there is another solution to the field equation: $(t - r/v)$. This is known as the *advanced* potential solution, resulting in advanced wave motion. Whereas retarded wave motion is when a wave travels from the origin outward to infinity, advanced wave motion is when a wave travels from infinity and collapses into the origin. This implies that reverse causality is real and that the wave can be detected at a remote location before it has been generated at the source!

Strangely, although this runs counter to common sense, Maxwell's equations and the laws of propagation do not favor ordinary retarded potential solutions over the more bizarre, time-reversed, advanced potential solutions. Indeed, N. Anderson, in his book *The Electromagnetic Field* (New York: Plenum, 1968), writes that, "Advanced potentials are now receiving a great deal of attention since they seem to be a means of avoiding some of the difficulties which beset electromagnetic theory. Advanced potentials were first invoked to try to solve the problem of obtaining an equation of motion for an electron moving in an electromagnetic

TRANSMISSION AND ABSORPTION OF SPHERICAL ELECTROMAGNETIC WAVES FROM A HERTZ DIPOLE EARTHED ON ONE SIDE.

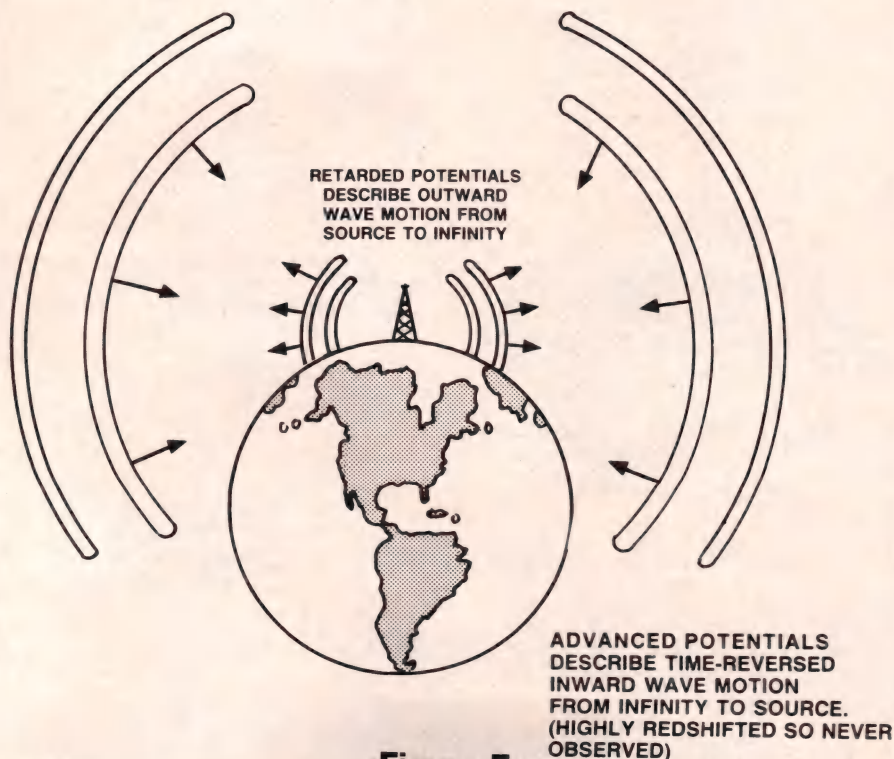


Figure 5.

field, which would take into consideration the radiation reaction, which is the force which acts on an electron due to its own electromagnetic field. Attempts using retarded potentials only are unsuccessful...."

Normally, the advanced solution is discarded, simply because no one has ever observed various parts of the distant universe "conspiring" to transmit incoming waves to radio and TV transmitters here on earth. But why doesn't this phenomenon occur? After all, it is known that various parts of the universe could be correlated in such a manner, since quantum mechanics and the EPR paradox state that all particles in the universe *do* somehow possess superluminal connections.

The best explanation centers on the fact that the universe is expanding rather than contracting or remaining stationary, so the electromagnetic radiation emanated by distant points of the universe is so red-shifted that it never reaches us. The expanding universe would even explain why time appears to travel in one direction: sources of energy can only be transmitters, never absorbers. Thus the apparent time asymmetry of the second law of thermodynamics and the "irreversible processes" that we observe associated with it are also explained. Systems can never return to their initial energy states (let alone *higher* energy states) because the universe is expanding and, as entropy increases, energy must be "diluted" more and more. An open container of liquid will evaporate away, never to return, and waves are only detectable when radiating from their sources since they never reach the other end of the universe — it keeps on expanding!

Man-Machine Communication

This should all be rather exciting to those who might one day build a computer based upon oddities in quantum theory and/or electrodynamics, allowing it to transcend the physical world in terms of processing speed. The "practical" barrier of about 1.5 trillion operations per second will be broken, but such superluminal computers will cause users additional problems.

For example, with so many signals spending a portion of their existence traveling faster than light, the large number of "negative cycles" of the processor clock that are necessary for the solution of increasingly difficult problems will result in the final answers appearing on the CRT screen or printer farther and farther back in time. At some point answers will begin appearing before the user has had a chance to key the question in!

To illustrate, let's say I wanted to ask a natural language processing AI program the question, "What prime number is closest to a trillion?" If I sat down at a terminal and keyed in this question, the

answer would appear on the screen just *before* I sat down. A little disconcerting, but tolerable. Note that even though I already have the answer I (or somebody else) must at some point key in the question; otherwise, the question is never given to the processor and I will not have the answer! Sounds paradoxical, doesn't it? But it is perfectly logical. Causation is still causation, whether it be backward or forward.

But let's say that the answer appeared, and I felt particularly lazy that day and decided that I was not under any circumstances going to key in that question! What would happen? Would the universe come to an end? Would Dr. Who materi-

alize and give me a strong lecture on space-time misbehavior?

No. When one thinks of the process only in terms of cause and effect, momentarily forgetting the direction of time, one realizes that the appearance of an answer on the screen means that a question *is* keyed into the keyboard, regardless of "time's arrow." Yours Truly or someone else *must* key in the question in the future, because now the answer is on the screen here in the past. This does not affect the idea of free will; in the future we are perfectly free to choose whether or not we want to key in the question (for example, we could decide by flipping a coin). But if we don't ask a question, of course, we

PRICE BREAKTHROUGH

The wait-loss experts have done it again!

512Kbyte SemiDisk with SemiSpool™ \$1095

Time was, you thought you couldn't afford a SemiDisk. Now, you can't afford to be without one.

	256K	512K	1Mbyte
SemiDisk I, S-100	\$895	\$1095	\$1795
IBM PC		\$1095	\$1795
TRS-80 Mdl. II, CP/M		\$1095	\$1795
SemiDisk II, S-100		\$1395	\$2095
Battery Backup Unit	\$150		
Version 5 Software Update	\$30		

Time was, you had to wait for your disk drives. The SemiDisk changed all that, giving you large, extremely fast disk emulators specifically designed for your computer. Much faster than floppies or hard disks, SemiDisk squeezes the last drop of performance out of your computer.

Time was, you had to wait while your data was printing. That's changed, too. Now, the SemiSpool print buffer in

our Version 5 software, for CP/M 2.2, frees your computer for other tasks while data is printing. With a capacity up to the size of the SemiDisk itself, you could implement an 8 Mbyte spooler!

Time was, disk emulators were afraid of the dark. When your computer was turned off, or a power outage occurred, your valuable data was lost. But SemiDisk changed all that. Now, the Battery Backup Unit takes the worry out of blackouts.

But one thing hasn't changed. That's our commitment to supply the fastest, highest density, easiest to use, most compatible, and most cost-effective disk emulators in the world.

SemiDisk.

It's the disk the others are ^{still} trying to copy.

SEMIDISK SYSTEMS, INC.

P.O. Box GG Beaverton, OR 97075 (503) 642-3100

Call 503-646-5510 for CBBS®/NW, a SemiDisk-equipped computer bulletin board. 300/1200 baud
SemiDisk, SemiSpool Trademarks of SemiDisk Systems CP/M Trademark Digital Research



Circle no. 63 on reader service card.

won't receive an answer in the past.

The longer it takes to work on a problem, the farther back in time the computer will answer. A truly difficult problem would take so many cycles of "negative time" to process that the answer would appear long before the question had even been formulated in the user's mind!

Now let's say that I asked the computer whether Gödel's proof is valid under all possible higher-order logics. The solution to that problem would take a great deal of negative time for the processor to come up with an answer. Perhaps years ago I saw the answer on the screen but dismissed it as a system malfunction, since I had not yet formulated the question in my mind or even knew what Gödel's proof was. Perhaps the negative time required for computing the answer is longer than the time the computer has been operational, so one never gets to see the answer! From the superluminal processor's "reversed-time" point of view, the computer would appear to have been disassembled while in the process of determining the answer. To our forward-time view, however, the computer had simply been assembled after the answer would have appeared on the screen, which would itself not have been manufactured yet. The first person to plug in the new computer, therefore, would be shocked to find the machine already working on a problem that it could never solve, since the system was not operational far enough back in time.

These problems could be alleviated — and new problems created — by typing the question into a memory buffer, just like a batch system, where a conventional computer and AI program would analyze the parameters of the question and estimate the appropriate amount of time to wait before sending the question to the superluminal processor. If the estimate were accurate, the delay period of submitting the question to the superluminal processor would be just a little longer than the negative time required for the answer. So if one keyed in a question, the answer would appear immediately afterward, even though the question had just been given to the delay buffer and not yet to the superluminal processor.

Of course, the more difficult the question, the longer it has to be kept in the delay memory buffer before being forwarded to the superluminal processor. If the user does not get an immediate response, then it means that the computer will be experiencing some mechanical difficulty between the time the question is keyed in and the time it is finally given to the superluminal processor. A mechanical problem or power failure is more damaging to a superluminal computer than it is to a conventional computer; although a physical interruption is the same whether one is looking at it while moving forward or

backward in time, the superluminal computer user must wait for the failure to occur in order to fix it. Preventive maintenance would come in handy at this point! Normally, the user would have to wait until the mechanical problem actually occurs before keying in the question. The computer is thus not only a diagnostician of its own mechanical problems but a *precognoscicator* of its future mechanical problems: the cessation of the computer's activity that prevents the answer's appearance represents another case of reverse causality, or information traveling backwards in time.

Brain-Processor Communication

With the sixth generation computer, the ultimate barrier between man and machine will finally be broken, eliminating the keyboard in favor of direct communication between the human brain and the computer. Experiments along this line have already been done, funded in some cases by CIA-type organizations in their attempts to develop a practical "thought-scanner."

When a human brain is exposed to some stimulus (such as a flash of light or the appearance of an alphanumeric symbol or an entire word), the segment of brain waves recorded by an electroencephalogram (EEG) about half a second later contains a waveform (the "evoked potential" or "event-related potential") that is a mental representation of the stimulus. The actual waveform is hidden, however, by "noise" — the unique spurious fluctuations introduced to the waveform by the individual brain undergoing analysis. The noise is eliminated and the actual waveform extracted by repeating the stimulus 50 or 100 times and then averaging all of the resulting recorded segments (each one slightly different from all the others because of the noise) and subjecting them to a Fourier analysis, which demonstrates the mathematical relationship between a complex periodic phenomenon and the simple harmonics that make it up.

The noise appears as harmonics of such complexity that for practical purposes it can be considered random noise; it cancels out once 100 samples are averaged. The final classification of the waveform includes not only the actual waveform with its fundamental wave and harmonics but the "latency" or length of time between the stimulus and the waveform's appearance.

Early success came in 1964, when W. Grey Walter and his colleagues at the Burden Neurological Institute in Bristol, England, discovered a wave that occurs whenever a subject anticipates something pleasurable (the so-called "expectancy wave"). In the same year, Samuel Sutton of the New York State Psychiatric Institute discovered the wave that we all

produce when we hear a phone or doorbell or see a sudden flash of light — the so-called "surprise wave." Later, Helen Neville of the Salk Institute for Biological Studies in La Jolla, California, found the wave given off whenever one focuses one's attention on one stimulus out of many — the "selective attention wave."

In 1980, Steven Hillyard and Marta Kutas of the University of California, San Diego, discovered a negative polarity wave with a latency of 400 milliseconds (N400 wave) that represents a confused reaction to something — the "double-take wave." Thus, a person's learning process can be monitored simply by noting when during a programmed instruction course the person's brain emits the N400 wave representing his or her confusion.

In terms of identifying the language functions, neurophysiologist Donald York and speech pathologist Thomas Jensen at the University of Missouri have found "motor template waves" associated with about 20 different syllables, and a Russian scientist has supposedly isolated specific waves for specific meanings. His theory is that the different waveforms representing, for example, *chair*, *desk*, and *table* are special variations of an underlying waveform representing the concept of *furniture*, which itself could be a particular variation of a still more general waveform representing the concept of *object* or *thing*.

Practical applications of computer brain wave analysis have already appeared. Erich Sutter at the Smith-Kettlewell Institute in San Francisco has designed a system where the user dons some electrodes and glances at a particular flashing light when the user wants the computer to command a servomechanism. Each light, flashing in a pattern unique from all other lights, is delegated to specific tasks. The distinctive waveform resulting from the particular flashing-light stimulus is extracted from the brain wave pattern by a computer and is compared to the library of waveforms in the computer's memory through another pattern-matching technique. When a match occurs, the program "knows" which light was observed by the user, and a corresponding I/O subroutine is triggered to activate a certain piece of equipment. This system can help the handicapped operate bionic extremities or enable pilots to maneuver aircraft while subjected to paralyzing g-forces.

All of this work is remarkable when one realizes that less than 10 percent of the brain cells move electrical charges of sufficient strength to generate electromagnetic waves and that the average EEG records only about 32 channels. The electrical firings of the other neurons remain unanalyzed, although Robert Thatcher of the University of Maryland has described a scheme whereby a set of microwave transmitters would surround the head of an individual and the inter-

COHERENT™ IS SUPERIOR TO UNIX* AND IT'S AVAILABLE TODAY ON THE IBM PC.

Mark Williams Company hasn't just taken a mini-computer operating system, like UNIX, and ported it to the PC. We wrote COHERENT ourselves. We were able to bring UNIX capability to the PC with the PC in mind, making it the most efficient personal computer work station available at an unbelievable price.

For the first time you get a multi-user, multitasking operating system on your IBM PC. Because COHERENT is UNIX-compatible, UNIX software will run on the PC under COHERENT.

The software system includes a C-compiler and over 100 utilities, all for \$500. Similar environments cost thousands more.

COHERENT on the IBM PC requires a hard disk and 256K memory. It's available on the IBM XT, and Tecmar, Davong and Corvus hard disks.

Available now. For additional information, call or write,

Mark Williams Company
1430 West Wrightwood, Chicago, Illinois 60614
312/472-6659



COHERENT is a trade mark of Mark Williams Company.
*UNIX is a trade mark of Bell Laboratories.

ference patterns produced between these beams and the brain's own waves would be recorded, processed by the computer, and played back as a 3-D moving picture of brain states and, therefore, mental processes — the perfect thought scanner.

Indeed, Dr. Glen Cartwright, a computer scientist and educational psychologist at McGill University, has already dubbed future brain-computer interactive devices "symbiotic minds" (*sym*, as in *symbiosis*, and *bionic*).

By wearing a specially designed helmet, the sixth generation computer user will be able to locate and communicate with any person or piece of data simply by thinking about it. But why should the user be limited to a particular location, wearing a helmet that is plugged into a computer? Why not totally remove all the burdens of physical instrumentation from the user by having the computer read his brain waves remotely, without anything being worn by the user at all!

After all, the longer the wavelength of an electromagnetic wave, the farther it will travel before losing its attenuation. As it turns out, the brain produces waves of a remarkably low frequency. These are the delta waves (1 to 2 cycles per second), theta waves (3 to 6 cycles per second), alpha waves (7 to 14 cycles per second), and beta waves (15 to 30 cycles per second).

A 5 cycle-per-second electromagnetic wave (such as a brain wave) loses only 5 percent of its total energy after traveling 10,000 kilometers. If a human cranium radiates a millionth of a watt at 5 cycles per second, one would measure about 10^{-24} watts per square centimeter on the other side of the world. This doesn't sound like much until one realizes that radio astronomers have detected remnant background radio noise from the Big Bang, emanating from deep in space, which is only about 10^{-40} watts per square centimeter.

Additionally, experiments in global communications with submarines indicate that some of these frequencies set up resonances; the timing is such that a wave, weakened from its round-the-world journey, is reinforced upon its return by the next broadcast wave. The lowest of these frequencies are 7.8, 14.1, and 20.3 cycles per second, two of these falling within the alpha region and one in the beta region, the realm of ordinary waking consciousness!

Conversely, electromagnetic waves can be broadcast from the computer to the human brain to complete the communication. Physicist John Taylor has remarked that, "An aggregate of a thousand million nerve cells, each a millimeter in length, could act as a folded aerial with a total length of over a thousand kilometers."

Muscle and nerve reactions to electromagnetic radiation between 50 and 200 cycles per second have reportedly been discovered in humans.

This kind of brain-computer communication would require huge antennas at the computer's location in order to receive the brain waves. We may, therefore, take one last step and apply the EPR effect of quantum mechanics to the problem. Instead of communicating by electromagnetic waves, the most advanced versions of the sixth generation computer (appearing sometime around the middle of the next century) will allow direct EPR coupling between the electrons in the human brain and the electrons in the computer's "transmitter/receiver."

In the 1951 edition of David Bohm's *Quantum Theory*, he comments on the idea of quantum aspects of brain processes that was put forth in an earlier work by Bohr (*Atomic Theory and the Description of Nature*): "In addition to such a classically describable mechanism that seems to act like a general system of communications [within the brain], Bohr's suggestion involves the idea that certain key points controlling this mechanism (which are, in turn, affected by the actions of this mechanism) are so sensitive and delicately balanced that they must be described in an essentially quantum-mechanical way. (We might, for example, imagine that such key points exist at certain types of nerve junctions.)"

One could now turn all of this around and ask if a sixth generation computer would, in fact, be conscious, since its "transmitter/receiver" would consist of halves of multiple two-particle systems correlated with their twin particles (and hence the mental processes) in the user's brain. This may be a meaningless question, since we do not even have a hint of what consciousness is in the brain.

Still, one is almost forced to speculate: are the laws of thought, even emotions and appreciations of beauty, reducible to physics, to special limiting cases of quantum theory? The pertinent facts could be distressing to those who would like to preserve a unique aspect of themselves despite the lessons of Copernicus, Darwin, and Freud, but fortunately for myself, I have just run out of editorial space.

DDJ

Lower Price!



We make C easy ...

... and work!

Whether you're a seasoned pro or just getting started with C, our Eco-C C compiler has everything you need.

- A full C compiler, including long, float and double.
- A library of more than 100 functions for faster program development.
- The compiler generates assembler output (Zilog mnemonics) for processing with Microsoft's MACRO 80 assembler and linker, both of which are included in the price.
- Extremely efficient code (e.g., Knuth's "seive" executes in 15.8 seconds).
- For a limited time, we include a copy of the **C Programming Guide**. The **Guide** and the Eco-C compiler provide an excellent environment for learning C.

Perhaps the best news is that we've lowered the price of Eco-C to \$250.00 and it includes a user's manual, the **Guide** and MACRO 80. Eco-C requires a Z80 CPU and CP/M (an 8088 version in the 2nd quarter). To order, call or write:



6413 N. College Ave.
Indianapolis, IN 46220
(317) 255-6476



Trademarks: Eco-C (Ecosoft), MACRO 80 (Microsoft), CP/M (Digital Research), Z80 (Zilog)

Circle no. 25 on reader service card.

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 194.

Bibliography

- Anderson, N. *The Electromagnetic Field*. New York: Plenum, 1968.
- Asby, R. "Some Consequences of Bremermann's Limit for Information Processing Systems," in *Cybernetic Problems in Bionics* (Bionics Symposium, 1966). Edited by H. L. Oestreicher and D. R. Moore, New York: Gordon & Breach, 1968.
- Bell, J. S. "On the Problem of Hidden Variables in Quantum Mechanics," *Review of Modern Physics*, 38 (1966). An elaboration of some ideas contained in his original paper as found in: *Physics*, 1 (1964-5) 195.
- Birkhoff, Garrett; Von Neumann, John. "The Logic of Quantum Mechanics," *Annals of Mathematics*, 37 (1936).
- Bledsoe, W. W. "A Basic Limitation of the Speed of Digital Computers," *IRE Trans. Electr. Comp.*, EC-10 (1961) 530.
- Bohm, David. *Quantum Theory*. Englewood Cliffs, NJ: Prentice-Hall, 1951.
- Born, Max. (Ed.) *The Born-Einstein Letters*. New York: Walker, 1971. See pp. 164-65, 168-76, 178, 188-89, 214-15.
- Bremermann, H. J. "Part I: Limitations on Data Processing Arising from Quantum Theory," in "Optimization Through Evolution and Recombination," in *Self-Organizing Systems*. Edited by M. C. Yovits, G. T. Jacobi and G. D. Goldstein, Washington, D. C.: Spartan Books, 1962.
- Bremermann, H. J. "Quantum Noise and Information," in *Proc. Fifth Berkeley Sympos. Math. Stat. a. Prob.*, Berkeley, CA: University of California Press, 1967.
- Bremermann, H. J. "Complexity of Automata, Brains and Behavior," in *Physics and Mathematics of the Nervous System*. Edited by M. Conrad, W. Güttinger and M. Dal Cin; *Biomathematics Lecture Notes*, Vol. 4, Heidelberg: Springer Verlag, 1974.
- Clauser, J. F.; Horne, M. A.; Shimony, A.; Holt, R. A. "Proposed Experiment to Test Hidden-Variable Theories," *Physics Review (Letters)* 23 (1969).
- Clauser, John F.; Shimony, Abner. "Bell's Theorem: Experimental Tests and Implications," *Reports on Progress in Physics*, 41 (1978) 1881-1927.
- Costa de Beauregard, O. *Revue Internationale de Philosophie*, 1: no. 61-62 (1962), and his subsequent paper found in *Dialectica*, 19 (1965) 280.
- Davies, P. C. W. *The Physics of Time Asymmetry*. London: Surrey University Press, 1974.
- Einstein, Albert. "Autobiographical Notes," in *Albert Einstein, Philosopher-Scientist*. Edited by Paul Schilpp, New York: Harper and Row, 1949.
- Einstein, Albert; Podolsky, Boris; Rosen, Nathan. "Can Quantum-Mechanical Description of Reality Be Considered Complete?" *Physical Review*, 47 (1935) 777-780.
- Freedman, Stuart J.; Clauser, John F. "Experimental Test of Local Hidden Variable Theories," *Physical Review Letters*, 28 (1972) 938ff.

- Hall, Joseph; Kim, Christopher; McElroy, Brien; Shimony, Abner. "Wave-Packet Reduction as a Medium of Communication," *Foundations of Physics*, 7 (October 1977) 759-767.
- Heisenberg, Werner. *Physics and Beyond*. New York: Harper and Row, 1971.
- Hooker, Clifford A. "Concerning Einstein's, Podolsky's, and Rosen's Objection to Quantum Theory," *American Journal of Physics*, 38 (July 1970) 851-857.
- Hooker, Clifford A. "The Nature of Quantum Mechanical Reality: Einstein Versus Bohr," in *Paradigms and Paradoxes*. Edited by Robert G. Colodny, Pittsburgh: University of Pittsburgh Press, 1972.
- Knuth, D. E. "Mathematics and Computer Science: Coping with Finiteness," *Science*, 194 (1976) 1235-1242.
- Kolata, Gina. "Does Gödel's Theorem Matter to Mathematics?" *Science*, 218 (1982) 779-780.
- Popper, Karl. *The Logic of Scientific Discovery*. New York: Basic Books, 1959. See pp. 244-45, 444-48, 457-64.
- Present, Gerald. "Understanding How the Universe Came Into Being: An Interview with John Archibald Wheeler," *Science Digest*, 86 (October 1975) 38-45.
- Reichenbach, H. *The Direction of Time*. Berkeley: University of California Press, 1971.

- Schrödinger, Erwin. "Discussions of Probability Relations between Separated Systems," *Proceedings of the Cambridge Philosophical Society*, 31 (1935) 555-562.
- Selden, Gary. "Machines that Read Minds," *Science Digest*, 89 (October 1981) 60ff.
- Stapp, Henry P. "The Copenhagen Interpretation and the Nature of Space-Time," *American Journal of Physics*, 40 (1972) 1098.
- Stapp, Henry P. "Bell's Theorem and World Process," *Il Nuovo Cimento*, 29B (1975) 271.
- Stapp, Henry P. "Are Superluminal Connections Necessary?" *Il Nuovo Cimento*, 40B (1977) 191-205.
- Stratton, J. A. *Electromagnetic Theory*. New York: McGraw-Hill, 1941.
- Taylor, John G. *The New Physics*. New York: Basic Books, 1972.
- Taylor, John G. *Superminds*. New York: Viking, 1975.
- Von Neumann, John. *The Mathematical Foundations of Quantum Mechanics*. (trans. Robert T. Beyer) Princeton: Princeton University Press, 1955.
- Zukav, Gary. *The Dancing Wu Li Masters: An Overview of the New Physics*. New York: William Morrow, 1979.

PT2x - Double Sided 48 ■ TeleVideo 802 ■ Associate/ Gnat ■ P
Superbrain Quad ■ BMC if800 ■ Sanya ■ IBM PC/ TI Pro (CP/M-86)
■ Morrow MD3 ■ Telcon (Zorba/ Nomis) ■ Olivetti M20 ■ NCR Deasid
820-II ■ RAIR Black Box ■ Toshiba T-100 PC ■ HP 86A ■ Micro Source M
KayPro IV ■ PT2x - Single Sided 48 ■ KayPro II ■ Osborne I ■ Osborne II
(8001A/ 8031) ■ Xerox 820-I ■ Xerox 820-II ■ TR5-80 Mod I ■ Morrow Mid
W/ Magnolia ■ Access ■ Zenith Z-100 ■ PC/M 550 (IBM 3740) ■ Xerox 820-I ■ TR5-8
■ Basic 4/AOS ■ Discovery
Digilog ■ Sanyo MBC 1200 ■ BMC Brother Micro ■ Northern Telecom 303 ■ Selko 8
Sing ■ 8 ■ 20
Side ■ 20
Xerox 820-I ■ TR5-8
MBC 5000 ■ PT2x - Single Sided 8 ■ CP/M 550 (IBM 3740) ■ Xerox 820-I ■ TR5-8
and Trout ■ SD Systems 50C-200 ■ Altas ■ CompuPro System 8/16 ■ Xerox 820-II
(CP/M) ■ CCSS/ Morrow ■ PT2x - Double Sided 48 ■ TeleVideo 802 ■ Associate/ G
■ Otrona ■ Heath Z-90 ■ Superbrain Quad ■ BMC if800 ■ Sanya ■ IBM PC/ TI Pro
Wangwriter ■ Epson QX-10 ■ Morrow MD3 ■ Telcon (Zorba/ Nomis) ■ Olivetti M20
■ Zenith Z-100 ■ Xerox 820-II ■ RAIR Black Box ■ Toshiba T-100 PC ■ HP 86A ■ A

DYNAMITE DOWNLOADER

NOW WITH: PC DOS

Discon System formats (initializes), reads, writes and converts over 100 5¼" (48 and 96 TPI) and 8" CP/M™ Disc Formats. The complete system, ready to use is only \$5995.00, no other equipment is necessary. Format Library updates are sent out at a nominal cost.

From:
Pacifica Technology, 11696 Sorrento Valley Road, San Diego, CA 92121 619/453-2945

CALL NOW FOR INSTANT ACCESS TO SCORES OF DISC FORMATS

CP/M is a Registered Trademark of Digital Research



DISCON

Circle no. 48 on reader service card.

A New Library for Small-C

The last installment on Small-C (*DDJ* Nos. 74 and 75) presented a meager function library that failed to stress compatibility with the Unix libraries. That shortcoming was quickly pointed out, and a number of people have gone on to develop their own "standard" libraries.

This article describes one such library, which was developed jointly by the authors. It was implemented under CP/M 2.2 and provides full support for the Small-C compiler and those programs that it compiles. Virtually all of the Unix functions that apply to foreign environments have been included. Naturally, standard files with I/O redirection and Unix-style command-line argument passing are supported. The MACRO-80 package was chosen for the project.

Other than for the arithmetic and logic library (a load module in this library), which remains essentially as Ron Cain presented it in 1980, only about 20 lines of assembly language code exist in this implementation. That makes even the low-level system functions much easier to understand and to adapt to other environments.

Some changes were made to the compiler itself with this implementation, so it has been redesignated **Version 2.1**. Except for the library, however, the differences from Version 2 are minor, so we only mention them in passing:

- (1) To reduce command-line clutter, a filename in the command line (not a redirection specification) causes the compiler to output to a file having the same name but with an extension of MAC; the default input file extension is C. If more than one file is specified, they are compiled into a single program bearing the name of the first file. If no filename is given, input and output are done on the standard input and output files, as before, and redirection may be used to change the default console assignments.
- (2) Undeclared functions are automatically declared to be external.
- (3) The syntax `(*func) ()` for declaring pointers to functions and for calling such functions is now accepted.
- (4) To accommodate the MACRO-80 package, the code-generating logic was changed and some functions were renamed to avoid clashes with reserved symbols and because MACRO-80 limits external names to six characters.
- (5) Fixes and enhancements reported in *DDJ* by Andrew Macpherson and Paul West have been applied, along with a number of other minor fixes.
- (6) Calls to nonstandard functions have been replaced by standard library calls.

A book entitled *The Small-C Handbook* is being printed by the Reston Publishing Company and should be available about the time you read this. It fully documents, from the

user's point of view, the Small-C language and compiler, including this library. Most of the material in this article's section "User Functions" is borrowed from the book.

Library Organization

Generally, each library function is compiled and assembled separately; it is then kept in a library of relocatable object modules, which we call CLIB.REL. Some functions that share common code or are otherwise related are grouped into a single module. Examples are `printf`, `fprintf`, and the low-level system functions found in the module CSYSLIB.

At link time, L80 is directed to search CLIB.REL to resolve external references. Everything needed to support the program under CP/M is loaded and linked into the resulting COM file. Modules that are not referenced are not loaded. The minimum set of functions loaded comes to 5.5K bytes.

Since L80 does not scan backwards to find a module, the library is organized so that backward references only involve modules that are known to be loaded; otherwise, the library is arranged alphabetically. The compiler always generates an external reference to `_link`:

```
_link: : ext _main
      end
```

This occurs first in the library and forces the loading of CSYSLIB, which follows. The last module in the library is CALL, the arithmetic and logic library. It is loaded last in order to establish the location where free memory begins.

System Functions

The low-level system functions in the source file CSYSLIB.C are shown in Listing One (page 60). The names of these functions and the global variables that they use begin with the underscore character to avoid clashes with user-written function and variable names. MACRO-80 accepts these despite a statement to the contrary in the documentation. We found, however, that older versions of MACRO-80 would not accept such names as external references.

Program Initiation and Termination

The last part of CALL contains the following code:

```
_end: lld 6           ;get bdos address
      sph           ;use for base of stack
      lxi h,_end    ;get start of free memory
      shld _memptr## ;use for memory allocation
      jmp _main##   ;parse command line,
                      ;execute program

      end _end
```

The label `_end` designates the end of the program and the beginning of free memory. As indicated by the last line, this is also where program execution begins. (L80 plants a jump to this address at the beginning of the user program.) This logic is executed once, after which its memory space becomes available for use by the program. It first sets SP to the base of BDOS, thus overlaying the CCP; then sets `_memptr` to the beginning of free memory; and finally jumps to `_main` to prepare for execution of the program.

The function `_parse` is called by `_main` to perform command-line parsing and I/O redirection. It first copies the CP/M

by James Hendrix and Ernest Payne

Copyright © 1984 L. E. Payne and J. E. Hendrix.

James Hendrix, Box 8378, University, MS 38677-8378.
Ernest Payne, 1331 W. Whispering Hills Dr., Tucson, AZ 85704.

Unix is a trademark of AT&T Bell Labs. MACRO-80 is a trademark of Microsoft Inc.

command line into a dynamically allocated buffer and then scans it, calling `_field` to isolate arguments and `_redirect` to alter the assignments of `stdin` and `stdout` (appending is supported). If a redirection open fails, the program aborts after displaying the letter R for "redirection error."

Finally, `argc` and `argv` are pushed onto the stack, and `main` is called to start program execution. On return, `exit` is called with a zero argument signifying successful completion. Of course, the program could also call `exit` directly and pass whatever error code it wishes; the error code, if it is nonzero, is written as a byte to the console. Any open files are closed and a warm start is performed.

The BDOS Interface

A bare-bones BDOS interface is provided as a function called `_bdos`. It takes two arguments: first the function code to be placed in the C register, then the value to be placed in the DE register pair before calling address 5. On return, HL (the primary register for Small-C) receives the CP/M return code from the A register.

This simple interface is sufficient to support the library functions. A more complete BDOS interface was described by Terje Bolstad in *DDJ* No. 80 (June 1983). His ideas could be applied here to provide more flexibility if that is desirable.

Memory Management

Memory is allocated in unlinked, contiguous blocks beginning at the end of the program. Each call to `_alloc` allocates one block of zeroed or uninitialized memory, depending on the value of the second argument. The standard functions `malloc` and `calloc` call `_alloc`.

Memory may be deallocated by calling `free` or `cfree`, but care must be taken to deallocate memory in the reverse order from which it was allocated. Deallocating memory simply places a new value in `_memptr`; everything above that address is considered free.

A function called `avail` may be called to find out how much memory lies between `_memptr` and the stack pointer. If there is a program/stack overlap, `avail` either returns zero or aborts the program after displaying the letter M for "memory error," as requested. `Malloc` and `calloc` abort this way if sufficient memory is unavailable.

File Management

Low-level Unix functions identify files by means of small integer values called file descriptors. Whereas the Unix Standard I/O Library uses a pointer to a file control structure, our library uses the file descriptor approach throughout, even though the library includes functions from the Standard I/O Library. The impact of this difference is negligible if one restricts file references to the values returned by the function `fopen` and the symbols `stdin`, `stdout`, and `stderr` (defined in the header file `STDIO.H` as 0, 1, and 2, respectively).

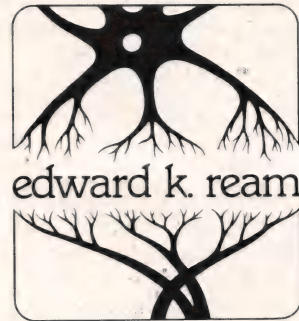
The symbol `MAXFILES` in `CLIB.DEF` determines how many files may be opened simultaneously. Seven integer arrays are dimensioned according to that value. They are:

`_status[MAXFILES]` — This is a bit-encoded status word indicating whether a file is open on the corresponding file descriptor; zero implies a closed condition. Separate bits authorize reading and writing, and there are bits for end-of-file and error conditions.

`_device[MAXFILES]` — This contains a nonzero code designating one of the CP/M logic devices when a nondisk file is opened on the corresponding file descriptor.

`_fcbptr[MAXFILES]` — When a disk file is first opened on a file descriptor, a standard CP/M file control block (FCB) is dynamically allocated; its address is kept here. When the file is closed, the FCB is saved for reuse. Recall

RED



FULL SCREEN EDITOR with FULL SOURCE CODE in C for CP/M 68K or CP/M 80

- RED is a powerful yet simple full screen text editor for both programmers and writers.
- RED features 17 commands including block move, block copy, search and substitute.
- RED comes with *full* source code in standard C. RED works as is with the BDS C, Aztec CII and Digital Research Compilers.
- RED supports *all* features of your terminal. You tailor RED to your terminal with an easy-to-use configuration program.
- RED handles files as large as your disk.
- RED is guaranteed. If for any reason you are not satisfied with RED, your money will be refunded promptly.

Price: \$95.

Call today for more valuable information:
(608) 231-2952

To order, send a check or money order to:

**Edward K. Ream
1850 Summit Avenue
Madison, Wisconsin 53705**

Your order will be mailed to you within one week. Sorry, I can not handle credit cards. Please do not send purchase orders unless a check is included. RED is distributed only on 8 inch CP/M format disks, but other disk formats are available through third parties.

Dealer inquiries invited.

that the memory allocation scheme is too primitive to allow indiscriminate freeing of memory. Likewise, the program must not free memory that was allocated before a disk file is opened.

_bufptr[MAXFILES] — As with the FCB, a buffer is allocated when a disk file is opened; its address is kept here. Buffers also are saved when a file is closed.

_chrpos[MAXFILES] — This is an offset to the next byte to be obtained from the corresponding buffer. Note that the current sector of a file is maintained in the random record number field in the FCB itself, and only random CP/M reads and writes are performed.

_dirty[MAXFILES] — A nonzero value here indicates that the corresponding buffer contains new data that needs to be written to disk.

_nextc[MAXFILES] — A character that has been pushed back into a file by `ungetc` is kept here. The value EOF (defined in `STDIO.H`) cannot be pushed back, so it indicates an empty bucket.

No attempt is made to save space in these arrays, since Small-C generates significantly more code to access character values than to access integers. Since these integer arrays are small, more space would be tied up in code than would be saved by making some of them character arrays.

The function `_mode` is used extensively to verify both that a file descriptor has a legal value and that the indicated file is open. If the file descriptor is valid, the status of its file is returned; otherwise, zero is returned.

The function `_open` is called by both `fopen` and `freopen`. It tries to open a file on a designated file descriptor. It verifies that the first character of the mode argument is either `r` (read), `w` (write), or `a` (append). If the filename is `CON:`, `LST:`, `PUN:`, or `RDR:`, it simply assigns the indicated logical device to the file descriptor and returns. Otherwise, it allocates an FCB and a buffer for the file, as necessary. It then calls `_newfcb` to validate the filename, force it to upper case, and initialize the FCB. Finally, it calls `_bdos` to open the file.

In the case of read mode, the first sector (128-byte CP/M record) of the file is automatically read into the buffer. In the case of write mode, if the file already exists, it is deleted before a new one is created. In the case of append mode, if the file does not exist, a new one is created; if the file does exist, it is opened, positioned at the beginning of the last block, then read to end-of-file by repeatedly calling `fgetc`. If a control-Z signals end-of-file, `_chrpos` is adjusted to begin writing at that position. Note that, while this approach avoids reading the entire file, a character stream file is presumed and embedded control-Z characters may be missed.

If a `+` follows the mode character (e.g., `r+`), an update mode is implied and `_status` is set to allow both reading and writing. This new feature of Unix/C is documented by C. D. Perez in *A Guide to the C Library for UNIX Users*. Apparently, under Unix/C one must call `fseek` or `rewind` when switching between read and write operations. Our library, however, permits unrestricted switching between reads and writes; each operation begins with the byte following the last one transferred. Since Small-C does not yet support long integers, we do not support `fseek`. Instead, `cseek` provides a seek to CP/M record boundaries.

When a read detects end-of-file, the EOF bit in `_status` is set, thereby disabling further reads; writes, however, are permitted. The EOF bit is cleared by a successful seek or rewind operation. Opening a file in write or append mode automatically sets the EOF bit. One may extend a file either by opening in append mode or by opening in read-update mode, reading to end-of-file, and then writing.

Unix performs only binary file transfers, and the end of a file is maintained as a pointer in the directory structure. It is up to the device drivers to translate between the newline char-

acter and the carriage return, line feed sequence. This scheme, however, cannot be followed under CP/M. First, there is no place in the CP/M file directory to store an end-of-file pointer. Second, in order to maintain ASCII file compatibility with other CP/M software, control-Z must be used to signal end-of-file, and the newline character must be translated to a carriage return, line feed sequence on output and vice versa on input.

Therefore, it was necessary to choose a means of discriminating between byte stream (binary) and character stream (ASCII) operations. It would not have violated the intent of the C developers to specify different, nonUnix open modes for this purpose. But we preferred to retain the standard open modes and distinguish between the I/O functions instead. In our library, calls to `read`, `fread`, `write`, and `fwrite` give binary transfers; all other calls (e.g., `fgetc`, `fgets`, etc.) give ASCII transfers. This makes Small-C programs upwardly compatible with Unix without changing the open modes.

Note that binary reads detect end-of-file only at the end of the last sector in a file. This is necessarily inconsistent with Unix, which can tie the end of a file to the byte.

Diagrammed in Figure 1 (page 54) are the principal functions involved in I/O transfers. Lines connecting the function names illustrate the possible flow of control. All input/output requests pass through either `_read` or `_write`. These perform only binary data transfers, one byte at a time. The logic for character stream operations is in `fgetc` and `fputc`, which in turn are called by the other character stream functions.

The functions `_conin` and `_conout` perform console communication. CP/M direct console I/O is used for all console communication. On output, this gives full control of the console device to the program. It also allows the program to poll the console (by means of the function `poll`) for operator input while writing data to the console.

Had conventional console I/O been used, CP/M would also poll for control characters, making it a matter of chance who would get an input character. Using CP/M direct console I/O meant that the customary keyboard input services (echo, rubout, etc.) had to be built into `_conin` and `fgets`. But, as a look at these functions will show, the cost was modest.

As their names imply, `_getsec` and `_putsec` transfer a sector of data between a buffer and the disk. They are called when buffers become empty or full.

Getting a sector involves first flushing the buffer to disk if it contains new data. Next, the random record number (RRN) of the FCB is advanced by calling `_advance`. Finally, the data is transferred by calling `_sector` (which calls `_bdos`). The end-of-file status is set if the attempt fails.

Writing a sector differs from reading by more than the direction of the data flow. The order of calls to `_sector` and `_advance` are reversed since the RRN now describes the position in the file where the newly filled buffer should go. After transferring the data, `_newbuf` is called to pad the buffer with control-Z characters in anticipation of further `_write` calls.

In keeping with the Unix concept of treating directories as ordinary files, CSYSLIB makes disk directories look like ASCII files of filenames (one to a line) to programs that read them. A file specifier consisting of only the drive identifier (e.g., `B:`) is taken to mean the directory on the indicated drive. The value `X:` indicates the default drive. Such "filenames" may be used for redirecting the standard input file (e.g., `<B:`) and they are accepted by the functions `fopen` and `freopen`. This feature is a compile option controlled by the symbol `DIR` in CSYSLIB; it takes an additional 0.3K bytes of memory. That seems a small price to pay for the flexibility it gives. Combined with a respectable set of Small-C "software tools," this feature makes the dynamic creation of SUBMIT files for performing multi-file operations a routine affair.

User Functions*

Listing Two (to be printed next month) shows the source code for the user-level functions. Most of them are patterned after Unix counterparts. Some, however, are unique to this library; these are designated as Small-C functions. A number of symbols defined in `STDIO.H` are mentioned. They are:

```
#define stdin  0 /* fd for standard input file */
#define stdout 1 /* fd for standard output file */
#define stderr 2 /* fd for standard error file */
#define ERR    -2 /* error condition return value */
#define EOF    -1 /* end-of-file return value */
#define NULL   0 /* value of a null character */
```

In addition, the abbreviation `fd` refers to a file descriptor.

Input/Output Functions

• `fopen (name, mode) char *name, *mode;`

This function attempts to open the file indicated by the null-terminated character string at `name`. `Mode` points to a string indicating the use for which the file is to be opened. The values for `mode` are:

```
"r"  - read
"w"  - write
"a"  - append
```

Read mode opens an existing file for input. Write mode either creates a new file or opens an old file and truncates it to permit writing to start at the beginning of the file. Append mode allows writing to begin at the end of an existing file or at the beginning of a new one.

In addition, there are modes that allow file updating (both reading and writing). They are:

```
"r+" - update read
"w+" - update write
"a+" - update append
```

These modes are the same as their nonupdate counterparts in terms of their effect at open time, but they also allow switching between read and write modes by interleaving calls to input and output functions.

Unless the program performs a seek or rewind operation, the next read or write operation begins at the point where the previous one finished. If the attempt to open a file is successful, `fopen` returns an `fd` value for the open file; otherwise, it returns `NULL`. The returned `fd` is then used in subsequent input/output function calls to identify the file. Only the standard files may be used without first calling `fopen`.

• `freopen (name, mode, fd) char *name, *mode; int fd;`

This function closes the previously opened file indicated by `fd` and opens a new one whose name is in the null-terminated character string at `name`. As for `fopen`, `mode` points to a character string indicating the open mode. It returns the original value of `fd` if the attempt is a success or `NULL` upon failure either to close the old file or to open the new one. Note, however, since the `fd` for the standard input file is zero, there is no way of distinguishing success from failure in that case.

• `fclose (fd) int fd;`

This function closes the specified file. If any new data is being held in the file's buffer, this data is first written to disk. It returns `NULL` on success or a nonzero value on error.

• `fgetc (fd) int fd; (alias getc)`

This function returns the next character from the file indicated by `fd`. If no more characters remain in the file or an error condition occurs, it returns `EOF`. The end of the file is detected when the implementation standard end-of-file character occurs or the physical end of the file is reached.

• `ungetc (c, fd) char c; int fd;`

This function logically (not physically) pushes the character `c` back into the file indicated by `fd`. The next read from that file will retrieve that character first. Only one character at a time may be held in waiting. This function returns the character itself on success; it returns `EOF` if a previously pushed character is being held or if `c` has the value of `EOF` (you cannot push `EOF` into a file). Performing a seek or rewind operation on a file causes a pushed character to be forgotten.

* Most of the material in this section is reprinted with permission of the publisher and the author from: James E. Hendrix, The Small-C Handbook, Reston Publishing Co., © 1984. Reston Publishing Co., 11480 Sunset Hills Road, Reston, VA 22090.

NOW FOR THE
IBM PC
+ COMPATIBLES



WINDOWS FOR C™

SCREEN MANAGEMENT TOOL FOR C PROGRAMMERS

COMPLETE WINDOW DISPLAY SYSTEM

- Unlimited windows and text files
- Horizontal and vertical scrolling
- Variable text margins
- ASCII file handling

SIMPLIFY • IMPROVE

- Menus
- Help files
- Data screens
- Editors

ALL DISPLAYS

ADVANCED FEATURES

- Instant screen changes
- No snow, no flicker
- Word wrap, auto scroll
- Overlay and restore windows
- Change attribute of selected text

C SOURCE MODULES FOR
menus, cursor control, ASCII file
display, text-mode bar graphs;
**+ complete building block
subroutines**

Available For: Lattice C, C86, Microsoft C, DeSmet C (MS or PC DOS)

Introductory Special \$119.95
(\$150 after May 31)
Demo disk & manual \$30
(Applies toward purchase)

A PROFESSIONAL SOFTWARE TOOL FROM
CREATIVE SOLUTIONS
21 Elm Ave., Box D5, Richford, VT 05476

For Order or Information: 802-848-7738
Master Card & Visa Accepted
Shipping \$2.50
VT residents add 4% tax

Circle no. 18 on reader service card.

- **getchar ()**

This function is equivalent to fgetc (stdin).

- **fgets (str, sz, fd) char *str; int sz, fd;**

This function reads up to sz-1 characters into memory from the file indicated by fd, starting at the address indicated by str. Input is terminated after transferring a newline character, and a null character is appended after the newline or in the last position if newline is not found. Fgets returns str for success; otherwise, it returns NULL for end-of-file or an error.

- **fread (ptr, sz, cnt, fd) char *ptr; int sz, cnt, fd;**

This function reads into memory from the file indicated by fd cnt items of data, sz bytes in length, starting at the address indicated by ptr. A count of the actual number of items read is returned to the caller (this might be less than cnt if the end of the file was encountered). This function performs a binary transfer; it does not convert carriage return, line feed sequences into newline characters, and it has no special regard for end-of-file bytes. It recognizes only the physical end of the file. You should call feof to determine when the data is exhausted and ferror to detect error conditions.

- **read (fd, ptr, cnt) int fd, cnt; char *ptr;**

This function reads cnt bytes of data into memory from the file indicated by fd, starting at the address indicated by ptr. A count of the actual number of bytes read is returned to the caller. This might be less than cnt if the end of the file was encountered. This function performs a binary transfer; it does not convert carriage return, line feed sequences into newline characters, and it has no special regard for end-of-file bytes. It recognizes only the physical end of the file. You should call feof to determine for sure when the data is exhausted and ferror to detect error conditions.

- **gets (str) char *str;**

This function reads characters into memory from stdin, starting at the address indicated by str. Input is terminated when a newline character is encountered, but the newline itself is not transferred; a null character terminates the input

string. Gets returns str for success and NULL for end-of-file or an error. Since this function may transfer any amount of data, you must check the size of the input string to verify that it has not gone beyond its allotted space.

- **feof (fd) int fd;**

This function returns a nonzero value if the file designated by fd has reached its end. Otherwise, it returns NULL.

- **ferror (fd) int fd;**

This function returns a nonzero value if the file designated by fd has encountered an error condition since it was opened. Otherwise, it returns NULL.

- **clearerr (fd) int fd;**

This function clears the error status for the file indicated by fd.

- **fputc (c, fd) char c; int fd; (alias putc)**

This function writes the character c to the file indicated by fd. It returns the character itself on success; otherwise, it returns EOF. If c is a newline character, then a carriage return, line feed pair is written.

- **putchar (c) char c;**

This function is equivalent to fputc (c, stdout).

- **fputs (str, fd) char *str; int fd;**

This function writes characters beginning at the address indicated by str to the file indicated by fd. Successive characters are written until a null byte is found. The null byte is not written and a newline character is not appended.

- **puts (str) char *str;**

This function works like fputs (str, stdout) except that it appends a newline character to the output.

- **fwrite (ptr, sz, cnt, fd) char *ptr; int sz, cnt, fd;**

This function writes from memory to the file indicated by fd cnt items of data, sz bytes long, starting at the address indicated by ptr. It returns a count of the number of items written.

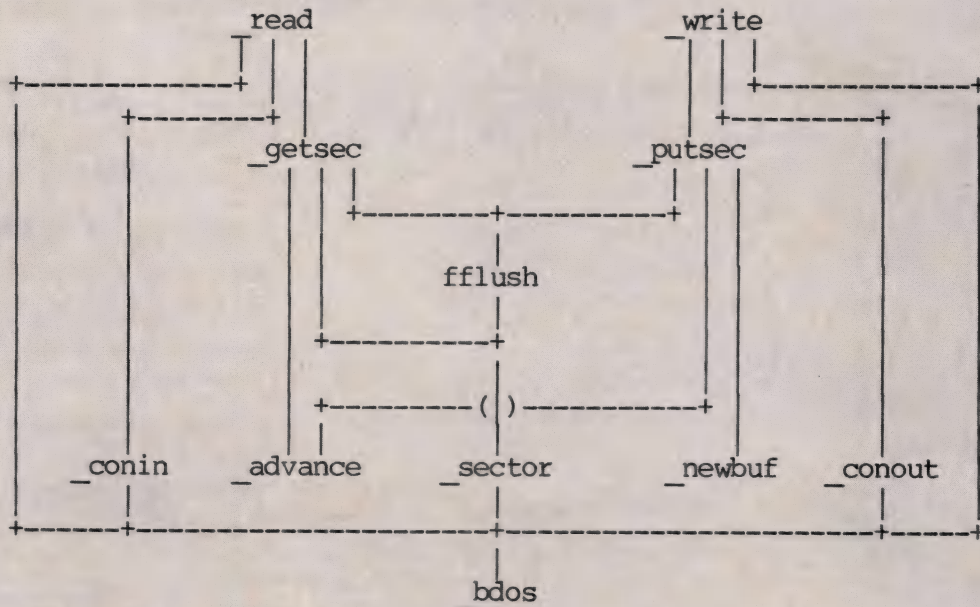


Figure 1.

Although an error condition may cause the number of items written to be less than cnt, you should call ferror to verify all error conditions. This function performs a binary transfer; it does not convert newline characters into carriage return, line feed sequences.

- **write (fd, ptr, cnt) int fd, cnt; char *ptr;**

This function writes from memory to the file indicated by fd cnt bytes of data, starting at the address indicated by ptr. It returns a count of the number of bytes written. An error condition may cause the number of bytes written to be less than cnt. You should call ferror to verify error conditions, however. This function performs a binary transfer; it does not convert newline characters into carriage return, line feed sequences.

- **fflush (fd) int fd;**

This function forces any system-buffered changes out to the file. Ordinarily, data written to a disk file is held in a memory buffer until the buffer becomes full, the buffer space is needed to hold a different sector of data from the disk, or the file is closed. Fclose calls this function. Fflush returns NULL on success or EOF on error.

- **cseek (fd, offset, from) int fd, offset, from;**

This Small-C function positions the file indicated by fd to the beginning of the 128-byte record that is offset positions from the first record, current record, or end-of-file, depending on whether from is 0, 1, or 2, respectively. Subsequent reads and writes proceed from that point. It returns NULL for success and EOF otherwise.

- **rewind (fd) int fd;**

This function positions the file indicated by fd to its beginning. It is equivalent to a seek to the first byte of the file. It returns NULL on success and EOF otherwise.

- **ctell (fd) int fd;**

This Small-C function returns the position of the current record of the file indicated by fd. The returned value is the offset of the current 128-byte record with respect to the first record of the file. If fd is not assigned to a disk file, -1 is returned.

- **unlink (name) char *name; (alias delete)**

This function deletes the file indicated by the null-terminated character string at name. It returns NULL on success and ERR otherwise.

- **rename (old, new) char *old, *new;**

This Small-C function changes the name of the file specified by old to the name indicated by new. It returns NULL on success and ERR otherwise.

- **auxbuf (fd, size) int fd, size;**

This Small-C function allocates an auxiliary buffer of size bytes for fd. It returns zero on success and ERR on failure. Fd must be open, and size must be greater than zero and less than the amount of free memory. If fd is a device, the buffer is allocated but ignored. Extra buffering is useful in reducing disk head movement or drive switching during sequential operations. Once an auxiliary buffer is allocated, it sticks for the duration of program execution, even if fd is closed. Calling this function a second time for the same fd returns ERR but otherwise has no effect. Alternating read and write operations or performing seeks produces unpredictable results; ungetc(), however, will operate normally. Ordinarily, it is counterproductive to allocate auxiliary buffers to both input and output files.

- **iscons (fd) int fd;**

MicroMotion

MasterFORTH

It's here — the next generation of MicroMotion Forth.

- Meets all provisions, extensions and experimental proposals of the FORTH-83 International Standard.
- Uses the host operating system file structure (APPLE DOS 3.3 & CP/M 2.x).
- Built-in micro-assembler with numeric local labels.
- A full screen editor is provided which includes 16 x 64 format, can push & pop more than one line, user definable controls, upper/lower case keyboard entry, A COPY utility moves screens within & between lines, line stack, redefinable control keys, and search & replace commands.
- Includes all file primitives described in Kernigan and Plauger's Software Tools.
- The input and output streams are fully redirectable.
- The editor, assembler and screen copy utilities are provided as relocatable object modules. They are brought into the dictionary on demand and may be released with a single command.
- Many key nucleus commands are vectored. Error handling, number parsing, keyboard translation and so on can be redefined as needed by user programs. They are automatically returned to their previous definitions when the program is forgotten.
- The string-handling package is the finest and most complete available.
- A listing of the nucleus is provided as part of the documentation.
- The language implementation exactly matches the one described in FORTH TOOLS, by Anderson & Tracy.
- Floating Point & HIRES options available.
- Available for APPLE II/II+/Ile & CP/M 2.x users.
- MasterFORTH — \$100.00. FP & HIRES — \$40.00 each (less 25% for FP & HIRES).
- Publications
 - FORTH TOOLS — \$20.00
 - 83 International Standard — \$15.00
 - FORTH-83 Source Listing 6502, 8080, 8086 — \$20.00 each.



Contact:

MicroMotion
12077 Wilshire Blvd., Ste. 506
Los Angeles, CA 90025
(213) 821-4340

This Small-C function returns a nonzero value if *fd* is assigned to the console; otherwise, it returns NULL.

- **isatty(*fd*) int *fd*;**

This function returns a nonzero value if *fd* is assigned to a device rather than a disk file; otherwise, it returns NULL.

Formatted Input/Output Functions

- **printf(*str*, *arg1*, *arg2*, . . .) char **str*;**

This function writes to the standard output file a formatted character string consisting of the null-terminated character array at *str*, laced at specific points with the character-string equivalents of the arguments:

arg1, *arg2* . . .

It also returns a count of the total number of characters written.

The string at *str*, which is called a control string, is required, but the other arguments are optional. The control string contains ordinary characters and groups of characters called conversion specifications. Each conversion specification informs *printf* how to convert the corresponding argument into a character string for output. The converted argument then replaces its conversion specification in the output. The character % signals the start of a conversion specification, and one of the letters b, c, d, o, s, u, or x ends it.

Between these may be found, in the order listed and with no intervening blanks, a minus sign, a decimal integer constant, and/or a decimal fraction. These subfields are all optional; in fact, one frequently sees conversion specifications with none of them. The minus sign indicates that the string, produced by applying a specified conversion to its argument, is to be left-adjusted in its field in the output. The decimal integer indicates the minimum width of that field (in characters); if more space is needed, it will be used, but at least the indicated number of positions will be generated. The decimal fraction is used where the argument being converted is itself a character string (or more correctly, the address of a character string). In this case the decimal fraction indicates the maximum number of characters to take from the string. If the specification has no decimal fraction, then all of the string is used.

The terminating letter indicates the type of conversion to be applied to the argument. It may be one of the following:

- b* The argument should be considered an unsigned integer and converted to *binary* format for output. No leading zeroes are generated. This specification is unique to Small-C and should be used with that in mind.
- c* The argument should be output as a *character* without any conversion, in which case the high-order byte will be ignored.
- d* The argument should be considered a signed integer and converted to a (possibly signed) *decimal* digit string for output. No leading zeroes are generated. The sign is the leftmost character; it is blank for positive and “-” for negative.
- o* The argument should be considered an unsigned integer and converted to *octal* format for output. No leading zeroes are generated.
- s* The argument is the address of a null-terminated character *string* that should be output as is, subject to the justification, minimum width, and maximum size specifications indicated.
- u* The argument should be considered an unsigned integer and converted to an *unsigned* decimal character string for output. No leading zeroes are generated.
- x* The argument should be considered an unsigned integer and converted to *hexadecimal* format for output. No leading zeroes are generated.

If a % is followed by anything other than a valid specification, the % is ignored and the next character is written without change. So %% writes %.

Printf scans the control string from left to right, sending everything to *stdout* until it finds a % character. It then evaluates the conversion specification that follows and applies it to the first argument (following the control string). The resultant string is written to *stdout*. *Printf* then resumes writing data from the control string until it finds another conversion specification; it applies that one to the second argument. The procedure continues until the control string is exhausted. The result is a formatted output message consisting of both literal and variable data.

- **fprintf(*fd*, *str*, *arg1*, *arg2*, . . .) int *fd*; char **str*;**

This function works like *printf* except that output goes to the file indicated by *fd*.

- **scanf(*str*, *arg1*, *arg2*, . . .) char **str*;**

This function reads a series of fields from the standard input file, converts the fields to internal format according to conversion specifications contained in the control string *str*, and stores them at the locations indicated by the arguments:

arg1, *arg2*, . . .

It returns a count of the number of fields read.

A field in the input stream is a contiguous string of graphic characters. It ends with the next white-space character (blank, tab, or newline) unless its conversion specification indicates a maximum field width, in which case it ends when the field width is exhausted. A field normally begins with the first graphic character after the previous field; that is, leading white space is skipped.

Since the newline character is skipped while searching for the next field, *scanf* reads as many input lines as required to satisfy the number of conversion specifications in its control string. Each of the arguments following the control string must yield an address value.

The control string contains both conversion specifications and white space (which is ignored). Each conversion specification informs *scanf* how to convert the corresponding field into internal format, and each argument following *str* indicates the address where the corresponding converted field is to be stored. The character % signals the start of a conversion specification, and one of the letters b, c, d, o, s, u, or x ends it.

Between these may be found, with no intervening blanks, an asterisk and/or a decimal integer constant. As in *printf*, these subfields are both optional. The asterisk indicates that the corresponding field in the input stream is to be skipped; skip specifications do not have corresponding arguments. The numeric field indicates the maximum field width (in characters). If present, it causes the field to be terminated when the indicated number of characters has been scanned, even if no white space is found; however, if a white-space character is found before the field width is exhausted, the field is terminated at that point.

The terminating letter indicates the type of conversion to be applied to the field. It may be one of the following:

- b* The field should be considered a *binary* integer and converted to an integer value. The corresponding argument should be an integer address. Leading zeroes are ignored. This specification is unique to Small-C and should be used with that in mind.
- c* The field should be accepted as a single *character* without any conversion. This specification inhibits the normal skip over white-space characters. The argument for such a field should be a character address.
- d* The input field should be considered a (possibly signed) *decimal* integer and converted into an integer value. The corresponding argument should be an integer address.

Leading zeroes are ignored.

- o* The field should be considered an *octal* integer and converted to an integer value. The corresponding argument should be an integer address. Leading zeroes are ignored.
- s* The field should be considered a character *string* and stored with a null terminator at the character address indicated by its argument. There must be enough space at that address to hold the string and its terminator. (Remember, you can specify a maximum field width to prevent overflow.) The specification *%ls* will read the next graphic character, whereas *%c* will read the next character, whatever it is.
- u* The field should be considered an *unsigned* decimal integer and converted to an integer value. The corresponding argument should be an integer address. Leading zeroes are ignored. This specification is unique to Small-C and should be used with that in mind.
- x* The field should be considered a *hexadecimal* number and converted to an integer value. The corresponding argument should be an integer address. Leading zeroes or a leading 0x or 0X will be ignored.

Scanf scans the control string from left to right, processing input fields until the control string is exhausted or a field is found that does not match its conversion specification. If the value returned by scanf is less than the number of conversion specifications, an error has occurred or the end of the input file has been reached. EOF is returned if no fields are processed because end-of-file has been reached.

- **fscanf(fd, str, arg1, arg2, . . .) int fd; char *str;**

This function works like scanf except that the input is taken from the file indicated by fd.

Format Conversion Functions

- **atoi(str) char *str;**

This function converts the decimal number represented by the string at str to an integer and returns its value. Leading white space is skipped, and an optional sign (+ or -) may precede the leftmost digit. The first nonnumeric character terminates the conversion.

- **atoi(str, base) char *str; int base;**

This Small-C function converts the unsigned integer of base base, represented by the string at str, to an integer and returns its value. Leading white space is skipped. The first non-numeric character terminates the conversion.

- **itoa(nbr, str) int nbr; char *str;**

This function converts the number nbr to its decimal character-string representation at str. The result is left-justified at str with a leading minus sign if nbr is negative. A null character terminates the string, which must be large enough to hold the result.

- **itoab(nbr, str, base) int nbr; char *str; int base;**

This Small-C function converts the unsigned integer nbr to its character-string representation at str in base base. The result is left-justified at str. A null character terminates the string, which must be large enough to hold the result.

- **dtoi(str, nbr) char *str; int *nbr;**



THE FULL-FEATURED KEYBOARD EXPANDER for all 8080-8085-Z80 computers using CP/M 2.2

MagiKey™ will redefine your keys as character strings . . . and transform single keystrokes into commands for programs, words for word processors, data for data bases, and messages for modems. Without hardware or system modifications.

MagiKey™ has more advanced features than any other CP/M keyboard expander. For example:

- ★ Redefine a key to send the string:
"Run WordStar and edit form letter number 17"
Hit the key, YOU will see the string, but "WS FRMLTR17" will be sent to CP/M. MagiKey™'s CONSOLE REDIRECTION can display messages which are invisible to programs and CP/M . . . very useful for recalling key assignments, custom operator prompts, and making CP/M friendlier.
- ★ Redefine a key to run several programs in sequence. Each program can wait for keyboard input or receive pre-defined commands and data. MagiKey™'s built-in BATCH PROCESSING doesn't use CP/M's SUBMIT, and handles programs that CP/M's XSUB can't.
- ★ Redefine a key to display the prompt:
"Execute SuperCalc using the spreadsheet file"
Press the key to display the prompt. Type the file name, hit RETURN, and you're into SuperCalc. When done, a single keystroke saves your updated spreadsheet. You don't have to remember or retype its name. MagiKey™'s RECURSIVE key redefinition mode automatically does it for you.

WE INVITE COMPARISON

\$100

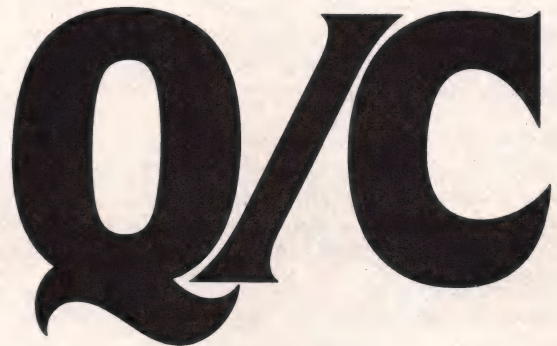
8" SSD, most 5 1/4" formats
add 6% tax in CA
check, VISA, M/C

CP/M (tm) Digital Research
SuperCalc (tm) Sorcim
WordStar (tm) Micropro



microSystems

16609 Sagewood Lane
Poway, California 92064
(619) 693-1022



For only \$95, Q/C is a ready-to-use C compiler for CP/M. You get complete source code for the compiler and over 75 library functions. Q/C is upward compatible with UNIX Version 7 C, but doesn't support long integers, float, parameterized #defines, and bit fields.

- Full source code for compiler and library.
- No license fees for object code.
- Z80 version takes advantage of Z80 instructions.
- Excellent support for assembly language and ROMs.
- Q/C is standard. Good portability to UNIX.

Version 3.2 of Q/C has many new features: structure initialization, faster runtime routines, faster compilation, and improved ROM support. Yes, Q/C has casts, typedef, sizeof, and function typing. The *Q/C User's Manual* is available for \$20 (applies toward purchase). VISA and MasterCard welcome.



5266 Hollister
Suite 224
Santa Barbara, CA 93111
(805) 683-1585

Q/C, CP/M, Z80, and UNIX are trademarks of Quality Computer Systems, Digital Research, Zilog, Inc., and Bell Laboratories respectively.

Circle no. 53 on reader service card.

Circle no. 9 on reader service card.

This Small-C function converts the (possibly) signed decimal number in the character string at *str* to an integer at *nbr* and returns the length of the numeric field found. The conversion stops when *atoi* finds the end of the string or any illegal numeric character. When working with 16-bit integers, a leading sign and five digits at most will be used.

- **atoi(*str*, *nbr*)** char **str*; int **nbr*;

This Small-C function converts the octal number in the character string at *str* to an integer at *nbr* and returns the length of the octal field found. It stops when it encounters a nonoctal digit in *str*. When working with 16-bit integers, six digits at most will be used.

- **utoi(*str*, *nbr*)** char **str*; int **nbr*;

This Small-C function converts the unsigned decimal number represented by the character string at *str* to an integer at *nbr* and returns the length of the numeric field found. It stops when it encounters the end of the string or any non-decimal character. When working with 16-bit integers, five digits at most will be used.

- **xtoi(*str*, *nbr*)** char **str*; int **nbr*;

This Small-C function converts the hexadecimal number in the character string at *str* to an integer at *nbr* and returns the length of the hexadecimal field found. It stops when it encounters a nonhexadecimal digit in *str*. When working with 16-bit integers, four digits at most will be used.

- **itod(*nbr*, *str*, *sz*)** int *nbr*, *sz*; char **str*;

This Small-C function converts *nbr* to a signed (if negative) character string at *str*. The result is right-justified and blank-filled in *str*. The sign and possibly the high-order digits are truncated if the destination string is too small. It returns *str*. *Sz* indicates the length of the string. If *sz* is greater than zero, a null byte is placed at *str[sz-1]*. If *sz* is zero, a search for the first null byte following *str* locates the end of the string. If *sz* is less than zero, all *sz* characters of *str* are used, including the last one.

- **itoo(*nbr*, *str*, *sz*)** int *nbr*, *sz*; char **str*;

This Small-C function converts *nbr* to an octal character string at *str*. The result is right-justified and blank-filled in the destination string. High-order digits are truncated if the destination string is too small. It returns *str*. *Sz* functions the same as in *itod*.

- **itou(*nbr*, *str*, *sz*)** int *nbr*, *sz*; char **str*;

This Small-C function converts *nbr* to an unsigned decimal character string at *str*. It works like *itod* except that the high-order bit of *nbr* is taken for a magnitude bit.

- **itox(*nbr*, *str*, *sz*)** int *nbr*, *sz*; char **str*;

This Small-C function converts *nbr* to a hexadecimal character string at *str*. In all other respects, it is identical to *itoo*.

String-Handling Functions

- **left(*str*)** char **str*;

This Small-C function left-adjusts the character string at *str*. Starting with the first nonblank character and proceeding through the null terminator, it moves the string to the address indicated by *str*.

- **pad(*str*, *ch*, *n*)** char **str*, *ch*; int *n*;

This Small-C function fills the string at *str* with *n* occurrences of the character *ch*.

- **reverse(*str*)** char **str*;

This function reverses the order of the characters in the null-terminated string at *str*.

- **strcat(*dest*, *sour*)** char **dest*, **sour*;

This function appends the string at *sour* to the end of the string at *dest*. The null character at the end of *dest* is replaced by the leading character of *sour*. A null character terminates the new *dest* string. The space reserved for *dest* must be large enough to hold the result. This function returns *dest*.

- **strncat(*dest*, *sour*, *n*)** char **dest*, **sour*; int *n*;

This function works like *strcat* except that a maximum of *n* characters from the source string are transferred to the destination string.

- **strcmp(*str1*, *str2*)** char **str1*, **str2*;

This function returns an integer less than, equal to, or greater than zero, depending on whether the string at *str1* is less than, equal to, or greater than the string at *str2*. Character-by-character comparisons are made, starting at the left end of the strings, until a difference is found. Comparison is based on the numeric values of the characters: *str2* is considered less than *str1* if *str2* is equal to but shorter than *str1*, and vice versa.

- **lexcmp(*str1*, *str2*)** char **str1*, **str2*;

This Small-C function works like *strcmp* except that a lexicographic comparison is used. For meaningful results, only characters in the ASCII character set (0-127 decimal) should appear in the strings. Alphabets are compared in dictionary order, with upper-case letters matching their lower-case equivalents. Special characters precede the alphabets and are themselves preceded by the control characters except DEL, which compares highest.

- **strncmp(*str1*, *str2*, *n*)** char **str1*, **str2*; int *n*;

This function works like *strcmp* except that a maximum of *n* characters are compared.

- **strcpy(*dest*, *sour*)** char **dest*, **sour*;

This function copies the string at *sour* to *dest*; *dest* is returned. The space at *dest* must be large enough to hold the string at *sour*.

- **strncpy(*dest*, *sour*, *n*)** char **dest*, **sour*; int *n*;

This function works like *strcpy* except that *n* characters are placed in the destination string regardless of the length of the source string. If the source string is too short, null padding occurs; if it is too long, it is truncated in *dest*. A null character follows the last character placed in the destination string.

- **strlen(*str*)** char **str*;

This function returns a count of the number of characters in the string at *str*. It does not count the null character that terminates the string.

- **strchr(*str*, *c*)** char **str*, *c*;

This function returns a pointer to the first occurrence of the character *c* in the string at *str*. It returns NULL if the character is not found. Searching ends with the first null character.

- **strrchr(*str*, *c*)** char **str*, *c*;

This function works like *strchr* except that the rightmost occurrence of the character is sought.

Character Classification Functions

The following functions determine whether or not a character belongs to a designated class of characters. They return *true* (nonzero) if it does and *false* (zero) if it does not.

- **isalnum(*c*)** char *c*;

This function determines if *c* is alphanumeric (A-Z, a-z, or 0-9).

- **isalpha(*c*)** char *c*;

This function determines if *c* is alphabetic (A-Z or a-z).

- **isascii(c) char c;**

This function determines if *c* is an ASCII character (decimal values 0-127).

- **isctrl(c) char c;**

This function determines if *c* is a control character (ASCII codes 0-31 or 127).

- **isdigit(c) char c;**

This function determines if *c* is a digit (0-9).

- **isgraph(c) char c;**

This function determines if *c* is a graphic symbol (ASCII codes 33-126).

- **islower(c) char c;**

This function determines if *c* is a lower-case letter (ASCII codes 97-122).

- **isprint(c) char c;**

This function determines if *c* is a printable character (ASCII codes 32-126). Spaces are considered printable.

- **ispunct(c) char c;**

This function determines if *c* is a punctuation character (all ASCII codes except control characters and alphanumeric characters).

- **isspace(c) char c;**

This function determines if *c* is a white-space character (ASCII SP, HT, VT, CR, LF, or FF).

- **isupper(c) char c;**

This function determines if *c* is an upper-case letter (ASCII codes 65-90).

- **isxdigit(c) char c;**

This function determines if *c* is a hexadecimal digit (0-9, A-F, or a-f).

- **lexorder(c1, c2) char c1, c2;**

This Small-C function returns an integer less than, equal to, or greater than zero depending on whether *c1* is lexicographically less than, equal to, or greater than *c2*. For meaningful results, only characters in the ASCII character set (0-127 decimal) should be passed. Alphabets are compared in dictionary order, with upper-case letters matching their lower-case equivalents. Special characters precede the alphabets and are themselves preceded by the control characters except DEL, which compares highest.

Character Translation Functions

- **toascii(c) char c;**

This function returns the ASCII equivalent of *c*. In systems that use the ASCII character set, it merely returns *c* unchanged. This function makes it possible to use the properties of the ASCII code set without introducing implementation dependencies into programs.

- **tolower(c) char c;**

This function returns the lower-case equivalent of *c* if *c* is an upper-case letter; otherwise, it returns *c* unchanged.

RP/M T.M.

By the author of Hayden's "CP/M Revealed."

New resident console processor RCP and new resident disk operating system RDOS replace CCP and BDOS without TPA size change.

User 0 files common to all users; user number visible in system prompt; file size and user assignment displayed by DIR; cross-drive command file search; paged TYPE display with selectable page size. SUBMIT runs on any drive with multiple command files conditionally invoked by CALL. An automatic disk flaw processing mechanism isolates unuseable sectors. For high capacity disk systems RDOS can provide instantaneous directory access and delete redundant nondismountable disk logins. RPMGEN and GETRPM automatically self-install RP/M on any computer currently running CP/M® 2.2. Source program assembly listings of RCP and RDOS appear in the RP/M user's manual.

Manual alone \$55; manual with RPMGEN.COM and GETRPM.COM with utilities on 8" SSD \$75. Shipping \$5 (\$10 nonUS). MC, VISA.

microMethods

P.O. Box G 118 SW First St.
Warrenton, OR 97146 (503) 861-1765



LATTICE® C Compilers

"My personal preferences are Lattice C in the top category for its quick compile and execution times, small incremental code, best documentation and consistent reliability;..."

BYTE AUG. 1983
R. Phraner

"... programs are compiled faster by the Lattice C compiler, and it produces programs that run faster than any other C compiler available for PC-DOS."

PC MAGAZINE JULY 1983
H. Hinsch

"... Microsoft chose Lattice C both because of the quality of code generated and because Lattice C was designed to work with Microsoft's LINK program."

PC MAGAZINE OCT. 1983
D. Clapp

"Lattice is both the most comprehensive and the best documented of the compilers. In general it performed best in the benchmark tests."

PERSONAL COMPUTER AGE NOV 1983
F. Wilson

"This C compiler produces good tight-running programs and provides a sound practical alternative to Pascal."

SOFTALK AUG 1983
P. Norton

"... the Lattice compiler is a sophisticated, high-performance package that appears to be well-suited for development of major application programs."

BYTE AUG 1983
Houston, Brodrick, Kent

To order, or for further information
on the LATTICE family of compilers, call or write:



LATTICE, INC.
P.O. Box 3072
Glen Ellyn, IL 60138
(312) 858-7950 TWX 910-291-2190



- **toupper(c) char c;**

This function returns the upper-case equivalent of c if c is a lower-case letter; otherwise, it returns c unchanged.

Mathematical Functions

- **abs(nbr) int nbr;**

This function returns the absolute value of nbr.

- **sign(nbr) int nbr;**

This function returns -1, 0, or +1, depending on whether nbr is less than, equal to, or greater than zero.

Program-Control Functions

- **calloc(nbr, sz) int nbr, sz;**

This function allocates nbr*sz bytes of zeroed memory. It returns the address of the memory block on success and zero otherwise.

- **malloc(nbr) int nbr;**

This function allocates nbr bytes of uninitialized memory. It returns the address of the memory block on success and zero otherwise.

- **avail(abort) int abort;**

This Small-C function returns the number of bytes of free memory that are available between the program and the stack. It also checks to see whether the stack overlaps allocated memory; if so and if abort is not zero, the program is aborted, and the letter "S" is displayed on the console to indicate that a stack error has occurred. If abort is zero, however, avail returns zero to the caller. This function makes it possible to make full use of all available memory, but care should be taken to leave enough space for the stack to use.

- **free(addr) char *addr; (alias cfree)**

This function frees up a block of allocated memory beginning at addr. It returns addr on success and NULL otherwise. It is necessary to free memory in the reverse order from which it was allocated. Freeing memory that was allocated before opening a file should be avoided since the open function dynamically allocates buffer and FCB space. You should not assume that closing a file relinquishes its space.

- **getarg(nbr, str, sz, argc, argv)
char *str; int nbr, sz, argc, *argv;**

This Small-C function locates the command-line argument indicated by nbr, moves it (null-terminated) to the string str of maximum size sz, and returns the length of the field obtained. Argc and argv must be the same values that are provided to the function main when the program is started. If nbr is zero, the program name is requested; if it is one, the first argument following the program name is requested; and so on. Because CP/M does not deliver the program name to a program, an asterisk is substituted in its place. If no argument corresponds to nbr, getarg puts a null byte at str and returns EOF.

- **poll(pause) int pause;**

This Small-C function polls the console for operator input. If no input is pending, zero is returned. If a character is waiting, the value of pause determines what happens. If pause is zero, the character is returned immediately. If pause is not zero and the character is a control-S, there is a pause in program execution; when the next character is entered from the keyboard, zero is returned to the caller. If the character is a control-C, program execution is terminated. All other characters are returned to the caller immediately.

- **exit(errcode) int errcode; (alias abort)**

This function closes all open files and returns to the operating system. If errcode is not zero, it is written to the console: a program that exits with a control-G (bell), for instance, would sound the console beeper.

Availability

As with Version 2, copies of this implementation of Small-C are available for \$25 (add \$3 for overseas postage) in 8-inch, SSSD and NorthStar CP/M formats. There is no restriction on noncommercial distribution. A package of software tools written in Small-C is also available for \$35. *The Small-C Handbook* may be obtained for \$14.95. Inquiries about any of these items should be addressed to James Hendrix. For people interested in other formats and adaptations, James Hendrix is willing to act as a clearing house as long as the burden does not become too great. Please include a self-addressed, stamped envelope with your inquiry.

Conclusion

No doubt the Small-C compiler and its library will continue to develop as more and more people with access to the source code take an interest in it and report their developments. Some obvious areas for improvement in the library are:

- (1) A better memory allocation scheme that permits allocation and deallocation operations to be performed in any order.
- (2) Adapting this implementation to other CPUs and operating systems. This library should be especially easy to port to other environments because it is written in C and the logic seems easy to follow.
- (3) Improvements in efficiency. No doubt this code can be made smaller and faster in many ways. We would hope, however, that such efforts would not obscure the simplicity and transparency of the logic.

We would like to express our appreciation to Ron Cain, who started the ball rolling in 1980, and to *Dr. Dobb's* for its continued support of Small-C.

DDJ

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 195.

Small-C Library (Text begins on page 50) Listing One

```

1 /*
2 ** STDIO.H -- Standard Small-C Definitions
3 **
4 ** Copyright 1984 L. E. Payne and J. E. Hendrix
5 */
6 #define stdin  0
7 #define stdout 1
8 #define stderr 2
9 #define ERR    (-2)
10 #define EOF    (-1)
11 #define YES    1
12 #define NO     0
13 #define NULL   0
14 #define CR     13
15 #define LF     10

```



```

16 #define BELL      7
17 #define SPACE
18 #define NEWLINE LF      /*23*/ /*45*/

1 /*
2 ** CLIB.DEF -- Definitions for Small-C library functions.
3 **
4 ** Copyright 1983 L. E. Payne and J. E. Hendrix
5 **
6 ** Credits:
7 ** 1) This library of Small-C functions was produced
8 ** jointly by:
9 **
10 ** Ernest Payne
11 ** 1331 W. Whispering Hills Drive
12 ** Tucson, AZ 85704
13 **
14 ** and
15 **
16 ** James E. Hendrix
17 ** Box 8378
18 ** University, MS 38677-8378
19 **
20 ** 2) The function _bdos() is an adaption of
21 ** Gene Cotton's work reported by Ron Cain (DDJ #48).
22 **
23 ** 3) The functions _parse(), _field(), and _redirect()
24 ** are a revision of Jan-Henrik Johansson's setarg()
25 ** (DDJ #74), and getarg() is a modification of his
26 ** revision of James Hendrix' function (DDJ #75).
27 **
28 ** 4) The standard C functions were obtained from
29 ** "A Guide to the C Library for UNIX User's
30 ** by C. D. Perez of Bell Laboratories.
31 **
32 */
33
34 /*
35 ** Definition of CP/M FCB and additional parameters
36 */
37 #define FCBSIZE 36 /* size of file control block */
38 #define DRIVE 0 /* CP/M drive designator offset */
39 #define NAMEOFF 1 /* CP/M file name offset */
40 #define NAMEOFF2 16 /* CP/M 2nd file name offset */
41 #define NAMESIZE 8 /* CP/M file name size */
42 #define TYPEOFF 9 /* CP/M file type offset */
43 #define TYPESIZE 3 /* CP/M file type size */
44 #define NTSIZE 11 /* CP/M file name & type size */
45 #define RRNOFF 33 /* CP/M random record number offset */
46 #define CPMEOF 26 /* CP/M end-of-file byte */
47 #define BUFSIZE 128 /* size of I/O buffer */
48 #define MAXFILES 10 /* maximum open files */
49 /*
50 ** CP/M function calls
51 */
52 #define CLOFIL 16 /* close file */
53 #define DCONIO 6 /* direct console i/o */
54 #define DELFIL 19 /* delete file */
55 #define FNDFIL 17 /* find first occurrence of a file */
56 #define FNDNXT 18 /* find next occurrence of a file */
57 #define GETPOS 36 /* get number of current sector */
58 #define GOCPM 00 /* go to CP/M */
59 #define LSTOUT 05 /* list output */

```

(Continued on next page)

MATH SUBROUTINE LIBRARY



Now, a library of **Numerical Methods**
Subroutines for use with your **FORTRAN**
programs.

Over sixty subroutines of:

FUNCTIONS	INTERPOLATION
INTEGRATION	LINEAR SYSTEMS
MATRICES	POLYNOMIALS
NON-LINEAR SYSTEMS	DIFFERENTIAL EQ

Versions available for several FORTRAN
compilers running under **CP/M-80** and **MS-DOS**
(PC-DOS).

Cost. \$250.
Manual available. \$25.

microSUB:MATH

CP/M and MS-DOS are trademarks of Digital Research Corp
and Microsoft Corp. respectively

Circle no. 26 on reader service card.

Elegance
Power
Speed



C Users' Group
Supporting All C Users
Box 287
Yates Center, KS 66783

Circle no. 19 on reader service card.

foehn consulting, PO Box 5123, Klamath Falls, OR 97601 503/884-3023

Small-C Library (Listing Continued, text begins on page 50)

Listing One

```
60 #define MAKFIL 22 /* make file */
61 #define OPNFIL 15 /* open file */
62 #define PQSEND 35 /* position file to end */
63 #define PUNOUT 04 /* punch output */
64 #define RENAME 23 /* rename file */
65 #define RDRND 33 /* read sector randomly */
66 #define RDRINP 03 /* reader input */
67 #define SETDMA 26 /* set dma */
68 #define WRTRND 40 /* write sector randomly */
69 /*
70 ** Device codes
71 */
72 #define CPMCON DCONIO /* console */
73 #define CPMRDR RDRINP /* reader */
74 #define CPMUN PUNOUT /* punch */
75 #define CPMLST LSTOUT /* list */
76 /*
77 ** File status bits
78 */
79 #define RDBIT 1 /* open for read */
80 #define WRTBIT 2 /* open for write */
81 #define EOFBIT 4 /* eof condition */
82 #define ERRTBIT 8 /* error condition */
83 /*
84 ** ASCII characters
85 */
86 #define ABORT 3
87 #define RUB 8
88 #define PAUSE 19
89 #define WIPE 24
90 #define DEL 127

1
2 /*
3 ** CSYSLIB -- System-Level Library Functions
4 **
5 ** Copyright 1984 L. E. Payne and J. E. Hendrix
6 */
7
8 #include stdio.h
9 #include clib.def
10 #define NOCCARGC /* no argument count passing */
11 #define DIR /* compile directory option */
12
13 /*
14 ***** System Variables *****
15 */
16
17 int
18 _auxsz, /* addr of _xsize[] in AUXBUF */
19 _auxef, /* addr of _x eof[] in AUXBUF */
20 _auxrd, /* addr of _xread() in AUXBUF */
21 _auxwt, /* addr of _xwrite() in AUXBUF */
22 _auxfl, /* addr of _xflush() in AUXBUF */
23
24 _cnt=1, /* arg count for main */
25 _vec[20], /* arg vectors for main */
26
27 _status[MAXFILES] = {RDBIT, WRTBIT, RDBIT|WRTBIT},
28 /* status of respective file */
29 _device[MAXFILES] = {CPMCON, CPMCON, CPMCON},
30 /* non-disk device assignments */
31 _nextc[MAXFILES] = {EOF, EOF, EOF},
32 /* pigeonhole for ungetc bytes */
33 _fcbptr[MAXFILES], /* FCB pointers for open files */
34 _bufptr[MAXFILES], /* buffer pointers for files */
35 _chrpos[MAXFILES], /* character position in buffer */
36 _dirty[MAXFILES]; /* "true" if changed buffer */
37
38 char
39 *_memptr, /* pointer to free memory. */
40 _argl[]="*"; /* first arg for main */
41
42 /*
43 ***** System-Level Functions *****
44 */
45
46 /*
47 ** -- Process Command Line, Execute main(), and Exit to CP/M
48 */
49 _main() {
50 _parse();
51 main(_cnt, _vec);
52 exit(0);
53 }
54
55 /*
56 ** Parse command line and setup argc and argv.
57 */
58 _parse() {
59 char *count, *ptr;
60 count = 128; /* CP/M command buffer address */
61 ptr = _alloc(count = *count%255, YES);
62 strncpy(ptr, 130, count-1);
63 _vec[0]=_argl; /* first arg = "*" */
64 while (*ptr) {
65 if(isspace(*ptr)) {++ptr; continue;}
66 switch(*ptr) {
67 case '<': ptr = _redirect(ptr, "r", stdin);
68 continue;
69 case '>': if(*(ptr+1) == '>')
70 ptr = _redirect(ptr+1, "a", stdout);
71 else ptr = _redirect(ptr, "w", stdout);
72 continue;
73 default: if(_cnt < 20) _vec[_cnt++] = ptr;
74 ptr = _field(ptr);
75 }
76 }
77 }
78
79 /*
80 ** Isolate next command-line field.
81 */
82 _field(ptr) char *ptr; {
83 while(*ptr) {
84 if(isspace(*ptr)) {
85 *ptr = NULL;
86 return (++ptr);
87 }
88 }
89 }
```

(Continued on page 64)

Available now.
The Best of Both Worlds
 High-performance

CompuPro Hardware
 with high-performance

Cromemco Software.

Cromemco's MC68000-Z80 CROMIX multi-tasking operating system with drivers to support CompuPro hardware. (requires Cromemco DPU)

Minimum configuration:

DPU - SystemSupport1 - Disk1 - Interfacer3 or 4 - 192K RAM

CROMIX with drivers to support minimum configuration \$890.

Special drivers only \$295.

The following products can be added to any 8 or 8-16 bit CROMIX system:

SCSI hard disk drivers \$195.

15Mb formatted hard disk subsystem \$2095.
 30Mb (two drives) \$2995.

MDrive-H drivers \$195.

CompuPro 512K MDrive-H hardware \$1695.

Other drivers in development... custom inquiries welcome.

Authorized CompuPro Dealer.

PuterParts®

2004 4th Avenue

P.O. Box 12339

Seattle, WA 98111-4339

Telephone (206) 682-2590

OPEN

2-6 Tuesday-Saturday

"PuterParts" is a registered trademark of Katharos Companies

Additional trademarks: Z80, Zilog, MC68000, Motorola, CROMIX, DPU, Cromemco, SystemSupport1, Disk1, Interfacer3, -4, MDrive-H, CompuPro.

Circle no. 56 on reader service card.

8748

**CP/M SIMULATOR/DEBUGGER
 FOR THE INTEL 8748/8048**

ANNOUNCING SIM48

- SIM48 allows you to load, trace, execute and save Intel 8748/8048 software using standard Intel Hex files.
- SIM48 allows you to simulate all instruction operations, timer/counter operations, I/O operations, interrupt processing, reset execution, internal and external RAM and ROM.
- SIM48's command set includes load, breakpoint, assemble, list (disassemble), trace, call and execute commands (as seen in DDT and ZSID).
- SIM48 allows you to simulate all software operations of the 8748/8048, yet costs 1/20th of an In-Circuit Emulator.
- SIM48 is CP/M compatible. Supplied on an 8" SSSD diskette.
- SIM22 (for Intel 8021/8022's) and SIM51 (for Intel 8751/8051's) soon to be released.

SIM48 \$150.00 SIM48 Manual \$20.00

Plus shipping and handling.
 N.Y. State residents add sales tax.
 Mastercard/Visa

Logical Systems

6184 TEALL STATION
 SYRACUSE, NY 13217
 (315) 457-9416

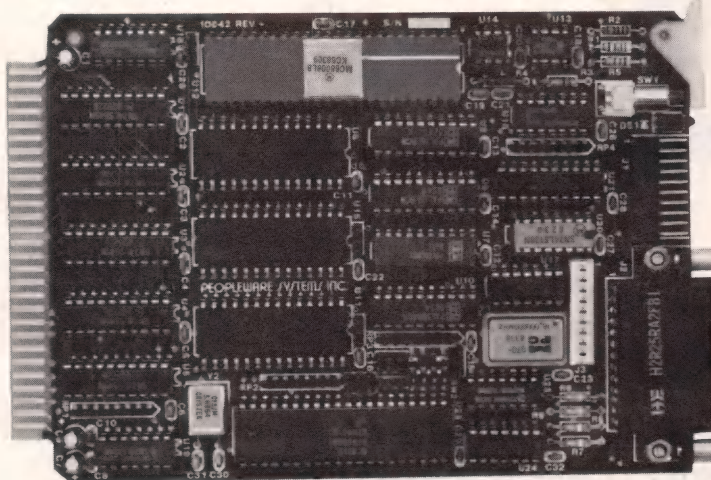
SIM48, SIM22, and SIM51 are trademarks of Logical Systems Corporation.
 CP/M, ZSID, and DDT are trademarks of Digital Research.

Circle no. 37 on reader service card.

68000 SINGLE BOARD COMPUTER FOR STD BUS

FEATURES

- 8 MHz 68008 Processor
- 32K On-board Memory Space (three 28-pin JEDEC sockets)
- One Megabyte Address Range (non-multiplexed address bus)
- 68681 DUART
- Dual RS232 Serial I/O Ports
- TTL Parallel I/O Port



FEATURES

- 16-Bit Timer
- Four Layer PC Board
- STD Bus Compatible
- Monitor EPROM Optional

ADDITIONAL PRODUCTS

- 6801 P-FORTH SBC
- I/O Cards
- Six Slot Card Cage with Integral Power Supply

**ENGINEERING
 SERVICES ALSO
 AVAILABLE.**

PEOPLEWARE SYSTEMS, INC.

5190 West 76th Street • Minneapolis, Minnesota 55435
 612-831-0827 TWX 9105761735

**CALL OR WRITE
 US TODAY
 612-831-0827**

Circle no. 50 on reader service card.

DeSmet C

The fastest 8088 C Compiler available

FULL DEVELOPMENT PACKAGE

- C Compiler
- Assembler
- Linker and Librarian
- Full-Screen Editor
- Newsletter for bugs/updates

SYMBOLIC DEBUGGER

- Monitor and change variables by name using C expressions
- Multi-Screen support for debugging PC graphics and interactive systems
- Optionally display C source during execution
- Breakpoint by Function and Line #

COMPLETE IMPLEMENTATION

- Both 1.0 and 2.0 DOS support
- Everything in K&R (incl. STDIO)
- Intel assembler mnemonics
- Both 8087 and Software Floating Point

OUTSTANDING PERFORMANCE

Sieve Benchmark

COMPILE 4 Sec. RAM —
22 Sec. FDISK
LINK 6 Sec. RAM —
34 Sec. FDISK
RUN 12 Sec.
SIZE 8192 bytes

**DeSmet C
Development Package \$159**

To Order Specify:

Machine _____

OS ☐ MS-DOS ☐ CP/M-86

Disk ☐ 8" ☐ 5 1/4 SS ☐ 5 1/4 DS

CWARE
CORPORATION

P.O. BOX 710097
San Jose, CA 95171-0097
(408) 736-6905

California residents add sales tax. Shipping: U.S. no charge, Canada add \$5, elsewhere add \$15. Checks must be on a US Bank and in US Dollars.

Small-C Library (Listing Continued, text begins on page 50) Listing One

```

87     }
88     ++ptr;
89     }
90     return (ptr);
91     }
92
93 /*
94 ** Redirect stdin or stdout.
95 */
96 _redirect(ptr, mode, std) char *ptr, *mode; int std; {
97     char *fn;
98     fn = ++ptr;
99     ptr = _field(ptr);
100    if(_open(fn, mode, std)==ERR) exit('R');
101    return (ptr);
102    }
103
104 /*
105 ** ----- File Open
106 */
107
108 /*
109 ** Open file on specified fd.
110 */
111 _open(fn, mode, fd) char *fn, *mode; int fd; {
112     char *fcb;
113     if(!strchr("rwa", *mode)) return (ERR);
114     _nextc[fd] = EOF;
115     if(_auxef) _auxef[fd] = NO;
116     if(strcmp(fn, "CON:") == 0) {
117         _device[fd] = CPMCON; _status[fd] = RDBIT|WRTBIT; return (fd);
118     }
119     if(strcmp(fn, "RDR:") == 0) {
120         _device[fd] = CPMRDR; _status[fd] = RDBIT; return (fd);
121     }
122     if(strcmp(fn, "PUN:") == 0) {
123         _device[fd] = CPMCON; _status[fd] = WRTBIT; return (fd);
124     }
125     if(strcmp(fn, "LST:") == 0) {
126         _device[fd] = CPMLST; _status[fd] = WRTBIT; return (fd);
127     }
128     if(fcb = _fcbptr[fd]) pad(fcb, NULL, FCBSIZE);
129     else {
130         if((fcb = _fcbptr[fd] = _alloc(FCBSIZE, YES)) == NULL
131            || (_bufptr[fd] = _alloc(BUFSIZE, YES)) == NULL)
132             return (ERR);
133     }
134     pad(_bufptr[fd], CPMEOF, BUFSIZE);
135     _dirty[fd] = _device[fd] = _chrpos[fd] = 0;
136 #ifdef DIR
137     if(fn[1] == ':' && fn[2] == NULL) { /* directory file */
138         pad(fcb, NULL, FCBSIZE);
139         pad(fcb+NAMEOFF, '?', NTSIZE);
140         if(toupper(fn[0]) != 'X') *fcb = toupper(fn[0]) - 64;
141         _chrpos[fd] = BUFSIZE;
142         _device[fd] = FNDFIL;
143         _status[fd] = RDBIT;
144         return (fd);
145     }

```



```

146 #endif
147 if(!_newfcb(fn,fcb)) return (ERR);
148 switch(*mode) {
149     case 'r': {
150         if(_bdos(OPNFIL,fcb)==255) return (ERR);
151         _status[fd] = RDBIT;
152         if(_sector(fd, RDRND)) _seteof(fd);
153         break;
154     }
155     case 'w': {
156         if(_bdos(FNDFIL,fcb)!=255) _bdos(DELFIL,fcb);
157         create:
158         if(_bdos(MAKFIL,fcb)==255) return (ERR);
159         _status[fd] = EOFBIT|WRTBIT;
160         break;
161     }
162     default: { /* append mode */
163         if(_bdos(OPNFIL,fcb)==255) goto create;
164         _status[fd] = RDBIT;
165         cseek(fd, -1, 2);
166         while(fgetc(fd)!=EOF);
167         _status[fd] = EOFBIT|WRTBIT;
168     }
169 }
170 if>(*mode+1)=='+' _status[fd] |= RDBIT|WRTBIT;
171 return (fd);
172 }
173
174 /*
175 ** Create CP/M file control block from file name.
176 ** Entry: fn = Legal CP/M file name (null terminated)
177 **          May be prefixed by letter of drive.
178 **          fcb = Pointer to memory space for CP/M fcb.
179 ** Returns the pointer to the fcb.
180 */
181 _newfcb(fn, fcb) char *fn, *fcb; {
182     char *fnptr;
183     pad(fcb+1, SPACE, NTSIZE);
184     if(*(fn + 1) == ':') {
185         *fcb = toupper(*fn) - 64;
186         fnptr = fn + 2;
187     }
188     else fnptr = fn;
189     if(*fnptr == NULL) return (NO);
190     fnptr = _loadfn(fcb + NAMEOFF, fnptr, NAMESIZE);
191     if(*fnptr == '.') ++fnptr;
192     else if(*fnptr) return (NO);
193     fnptr = _loadfn(fcb + TYPEOFF, fnptr, TYPESIZE);
194     if(*fnptr) return (NO);
195     return (YES);
196 }
197
198 /*
199 ** Load into fcb and validate file name.
200 */
201 _loadfn(dest, sour, max) char *dest, *sour; int max; {
202     while(*sour && !strchr("<.,;=?*[", *sour)) {
203         if(max-- < 0) *dest++ = toupper(*sour++);
204         else break;
205     }
206     return (sour);
207 }
208
209 /*
210 ** ----- File Input
211 */
212
213 /*
214 ** Binary-stream input of one byte from fd.
215 */
216 _read(fd) int fd; {
217     char *bufloc;
218     int ch;
219     switch (_mode(fd)) {
220         default: _seterr(fd); return (EOF);
221         case RDBIT:
222             case RDBIT|WRTBIT:
223             {
224                 if((ch = _nextc[fd]) != EOF) {
225                     _nextc[fd] = EOF;
226                     return (ch);
227                 }
228                 switch(_device[fd]) {
229                     /* PUN & LST can't occur since they are write mode */
230                     case CPMCON: return (_conin());
231                     case CPMRDR: return (_bdos(RDRINP,NULL));
232                     default:
233                         if(_auxsz && _auxsz[fd]) return (_auxrd[fd]);
234                         if(_chrpos[fd]==BUFSIZE && !_getsec(fd))
235                             return (EOF);
236                         bufloc = _bufptr[fd] + _chrpos[fd]++;
237                         return (*bufloc);
238                 }
239             }
240
241 /*
242 ** Console character input.
243 */
244 _conin() {
245     int ch;
246     while(!(ch = _bdos(DCONIO, 255))) ;
247     switch(ch) {
248         case ABORT: exit(0);
249         case LF:
250             case CR: _conout(LF); return (_conout(CR));
251         case DEL: ch = RUB;
252             default: if(ch < 32) { _conout('^'); _conout(ch+64); }
253                     else _conout(ch);
254                     return (ch);
255     }
256 }
257
258 /*
259 ** Read one sector from fd.
260 */
261 _getsec(fd) int fd; {
262 #ifdef DIR
263     if(_device[fd]) { /* directory file */
264         char *bp, *name, *type, *end;
265         _bdos(SETDMA, 128);
266         if((name = _bdos(_device[fd], _fcbptr[fd])) == 255) {
267             _seteof(fd);
268             return (NO);
269         }
270         _device[fd] = FNDNXT;
271         name = (name << 5) + (128 + NAMEOFF);
272         type = name + NAMESIZE;
273         end = name + NTSIZE;

```

(Continued on next page)

LISP

FOR THE IBM PERSONAL COMPUTER.

THE PREMIER LANGUAGE
OF ARTIFICIAL
INTELLIGENCE FOR
YOUR IBM PC.

■ DATA TYPES

Lists and Symbols
Unlimited Precision Integers
Floating Point Numbers
Character Strings
Multidimensional Arrays
Files
Machine Language Code

■ MEMORY MANAGEMENT

Full Memory Space Supported
Dynamic Allocation
Compacting Garbage Collector

■ FUNCTION TYPES

EXPR/FEXPR/MACRO
Machine Language Primitives
Over 190 Primitive Functions

■ IO SUPPORT

Multiple Display Windows
Cursor Control
All Function Keys Supported
Read and Splice Macros
Disk Files

■ POWERFUL ERROR RECOVERY

■ 8087 SUPPORT

■ COLOR GRAPHICS

■ LISP LIBRARY

Structured Programming Macros
Editor and Formatter
Package Support
Debugging Functions
.OBJ File Loader

■ RUNS UNDER PC-DOS 1.1 or 2.0

IQLISP

5¼" Diskette
and Manual _____ \$175.00
Manual Only _____ \$ 30.00

Integral Quality

P.O. Box 31970
Seattle, Washington 98103-0070
(206) 527-2918

Washington State residents add sales tax.
VISA and MASTERCARD accepted.
Shipping included for prepaid orders.

Small-C Library (Listing Continued, text begins on page 50)

Listing One

```

274     bp = _bufptr[fd] + BUFSIZE;
275     *--bp = CR;
276     while(--end >= name) { /* put filename at end of buffer */
277         if(*end == SPACE) continue;
278         *--bp = *end;
279         if(end == type) *--bp = '.';
280     }
281     _chrpos[fd] = bp - _bufptr[fd];
282     return (YES);
283 }
284 #endif
285 if(!flush(fd)) return (NO);
286 _advance(fd);
287 if(!_sector(fd, RDRND)) {
288     pad(_bufptr[fd], CPMEOF, BUFSIZE);
289     _seteof(fd);
290     return (NO);
291 }
292 return (YES);
293 }
294
295 /*
296 ** ----- File Output
297 */
298
299 /*
300 ** Binary-Stream output of one byte to fd.
301 */
302 _write(ch, fd) int ch, fd; {
303     char *bufloc;
304     switch (_mode(fd)) {
305         default: _seterr(fd); return (EOF);
306         case WRTBIT:
307         case WRTBIT|RDBIT:
308         case WRTBIT|EOFBIT:
309         case WRTBIT|EOFBIT|RDBIT:
310     }
311     switch(_device[fd]) {
312         /* RDR can't occur since it is read mode */
313         case CPMCON: return (_conout(ch));
314         case CPMUN:
315         case CPMLST: _bdos(_device[fd], ch);
316             break;
317         default:
318             if(!_auxsz && !_auxsz[fd]) return (_auxwt(ch, fd));
319             if(_chrpos[fd] >= BUFSIZE && !_putsec(fd)) return (EOF);
320             bufloc = _bufptr[fd] + _chrpos[fd]++;
321             *bufloc = ch;
322             _dirty[fd] = YES;
323     }
324     return (ch);
325 }
326
327 /*
328 ** Console character output.
329 */
330 _conout(ch) int ch; {
331     _bdos(DCONIO, ch);
332     return (ch);

```



```

333 }
334
335 /*
336 ** Write one sector to fd.
337 */
338 _putsec(fd) int fd; {
339     if(!flush(fd)) return (NO);
340     _advance(fd);
341     pad(_bufptr[fd], CPMEOF, BUFSIZE);
342     return (YES);
343 }
344
345 /*
346 ** ----- Buffer Service
347 */
348
349 /*
350 ** Advance to next sector.
351 */
352 _advance(fd) int fd; {
353     int *rrn;
354     rrn = _fcbptr[fd] + RRNOFF;
355     ++(*rrn);
356     _chrpos[fd] = 0;
357 }
358
359 /*
360 ** Sector I/O.
361 */

```

```

362 _sector(fd, func) int fd, func; {
363     int error;
364     _bdos(SETDMA, _bufptr[fd]);
365     error = _bdos(func, _fcbptr[fd]);
366     _bdos(SETDMA, 128);
367     _dirty[fd] = NO;
368     return (error);
369 }
370
371 /*
372 ** ----- File Status
373 */
374
375 /*
376 ** Return fd's open mode, else NULL.
377 */
378 _mode(fd) char *fd; {
379     if(fd < MAXFILES) return (_status[fd]);
380     return (NULL);
381 }
382
383 /*
384 ** Set eof status for fd and
385 ** disable future i/o unless writing is allowed.
386 */
387 _seteof(fd) int fd; {
388     _status[fd] != EOFBIT;
389 }
390

```

(Continued on next page)

The PROGRAMMER'S SHOP™ helps:

Ad Changed 3/5/84

Compare, evaluate, find products. **Get Answers.** GUARANTEES.

"C" LANGUAGE

	LIST PRICE	OUR PRICE
APPLE: AZTEC C-Full, ASM	\$199	call
8080: BDSC-Fast, popular	150	125
8080: AZTEC C-Full	199	call
Z80: ECOSOF-Fast, Full	250	225
8086: C86-optimizer, Meg	395	call
8086: Lattice-New 1.1 & 2.0	600	495
Microsoft (Lattice)	MSDOS	500 call
Digital Research - Megabyte	8086	350 269
Desmet by CWare-Fast	8086	109 99

BASIC

	ENVIRONMENT	LIST PRICE	OUR PRICE
Active Trace-debug	8080/86	\$ 80	72
MBASIC-80 - MicroSoft	8080	375	255
BASCOM-86 - MicroSoft	8086	395	279
CB-86 - DRI	CPM/86	600	439
Prof. BASIC	PCDOS	345	325
BASIC Dev 1 System	PCDOS	79	72

EDITORS Programming

BELLESOF - PASCAL	MSDOS	\$245	call
C Screen with source	8080/86	NA	60
EDIX	PCDOS	195	149
FINAL WORD	8080/86	300	215
MINCE	CPM, PCDOS	175	149
PMATE - powerful	CPM	195	175
	8086	225	195
VEDIT - full, liked	CPM, PCDOS	150	119
	8086	200	159

SERVICES

- Programmer's Referral List
- Compare Products
- Help find a Publisher
- Evaluation Literature free
- BULLETIN BOARD - 7 PM to 7 AM 617-461-0174
- Dealer's Inquire
- Newsletter
- Rush Order
- Over 300 products

PASCAL

	ENVIRONMENT	LIST PRICE	OUR PRICE
PASCAL MT + 86	CPM/86/IBM	\$400	\$289
without SPP	CPM80	350	249
MS PASCAL 86	MSDOS	350	255
SBB PASCAL - great, fast	PCDOS	350	315
PASCAL 64 - nearly full	COM 64	99	89

LANGUAGE LIBRARIES

C to dBASE interface	8080/86	\$125	\$115
C Tools 1 - String, Screen	PCDOS	NA	115
C Tools 2 - OS Interface	PCDOS	NA	92
C Tools - XOR - Graphics, Screen	NA	95	
FLOAT87 - Lattice, PL1	PCDOS	NA	115
GRAPH GSX-80	CPM80	NA	75
HALO	PCDOS	150	125
ISAM Access Manager-86	8086	400	300
PHACT - with C	PCDOS	NA	250
FABS	CPM80	150	135
PASCAL TOOLS	PCDOS	NA	115
SCREEN Display Mgr. 86	8086	500	375
PANEL-86 - many	PCDOS	350	315
WINDOWS - AMBER	PCDOS	295	call

FORTRAN

MS FORTRAN-86 - Meg	MSDOS	\$350	\$255
SS FORTRAN-86	CPM-86	425	345
FORTRAN-80 - '66 decent	CPM-80	500	350
INTEL FORTRAN-86	IBM PC	NA	1400
DR FORTRAN COMING			
RM FORTRAN COMING			

OTHER PRODUCTS

Microsoft ASM-86	MSDOS	100	85
Microshell improve CPM	8080	150	125
IQ LISP - full, 1000K RAM	PCDOS	175	call
PLINK-86 - overlays	8086	350	315
PL / 1-86	8086	750	560
Prolog - with samples	PCDOS	NA	125
MBP Cobol-86 fast	8086	750	695
COBOL - Level II	8086	1600	1275
TRACE-86 - debug	PCDOS	125	115
CODESMITH-86 - debug	PCDOS	195	139

NEW FEATURES

For MICROSOFT C

Halo-Graphics	\$125
Panel - Screen	\$315
PHACT - ISAM	\$250
C Tools 1 - String	\$115
C Tools 2 - OS Interface	\$ 92
Greenleaf - 200 functions	\$165
Others coming	

Free Report: PRODUCTIVITY USING MSDOS

Assume use of compiler and typical editor. What commercial or public domain products, what techniques improve productivity? "Productivity with MSDOS" is a growing document with some answers. Call to request it. **Help improve it.**

Earn \$50 credit toward any purchase when we add any description, code, or idea received from you.

SUGGESTED PRODUCTS FOR PRODUCTIVITY

- Full use of overlays, headers across 2.0 directories. **AKA ALIAS** \$60.
- Recover erased or damaged files - use **Norton Utilities** \$65 or **POWER** \$139.
- Improve on DEBUG with **Codesmith 86** \$135 many breakpoints/windows. Disasm.
- Analyze execution of any E X E with **Profiler** for \$175.
- 200 C functions for DOS interface, PC screen, graphics, etc. **Greenleaf** \$165.

RECENT DISCOVERIES HIGHLIGHTED

C Helper includes source in C for CP/M80. MSDOS for a DIFF, GREP, Flowcharter, XREF, C Beautifier and others. \$125.

Note: all prices subject to change without notice. Mention this ad. Some prices are specials.

Call for a catalog, literature, comparisons, prices. ALL FORMATS.

THE PROGRAMMER'S SHOP™

908-D Providence Highway, Dedham, MA 02026.
617-461-0120, Mass: 800-442-8070

VISA **800-421-8006** MC

Circle no. 52 on reader service card.

Small-C Library (Listing Continued, text begins on page 50)

Listing One

```

391 /*
392 ** Clear eof status for fd.
393 */
394 _clreof(fd) int fd; {
395     _status[fd] &= ~EOFBIT;
396 }
397
398 /*
399 ** Set error status for fd.
400 */
401 _seterr(fd) int fd; {
402     _status[fd] |= ERRBIT;
403 }
404
405 /*
406 ** ----- Memory Allocation
407 */
408
409 /*
410 ** Allocate n bytes of (possibly zeroed) memory.
411 ** Entry: n = Size of the items in bytes.
412 ** clear = "true" if clearing is desired.
413 ** Returns the address of the allocated block of memory
414 ** or NULL if the requested amount of space is not available.
415 */
416 _alloc(n, clear) char *n; int clear; {
417     char *oldptr;
418     if(n < avail(YES)) {
419         if(clear) pad(_memptr, NULL, n);
420         oldptr = _memptr;
421         _memptr += n;
422         return (oldptr);
423     }
424     return (NULL);
425 }
426
427 /*
428 ** ----- CP/M Interface

```

```

429 */
430
431 /*
432 ** Issue CP/M function and return result.
433 ** Entry: c = CP/M function code (register C)
434 **         de = CP/M parameter (register DE or E)
435 ** Returns the CP/M return code (register A)
436 */
437 _bdos(c,de) int c,de; {
438     #asm
439         pop     h           ;hold return address
440         pop     d           ;load CP/M function parameter
441         pop     b           ;load CP/M function number
442         push    b           ;restore
443         push    d           ; the
444         push    h           ; stack
445         call    5           ;call bdos
446         mvi     h,0         ;
447         mov     l,a         ;return the CP/M response
448     #endasm
449 }

```

End Listing One

Listing Two

File: ABS.C

```

1 /*
2 ** abs -- returns absolute value of nbr
3 */
4 abs(nbr) int nbr; {
5     if(nbr < 0) return (-nbr);
6     return (nbr);
7 }

```

File: ATOI.C

```

1 #define NOCCARGC /* no argument count passing */
2 /*
3 ** atoi(s) - convert s to integer.
4 */
5 atoi(s) char *s; {
6     int sign, n;
7     while(isspace(*s)) ++s;
8     sign = 1;
9     switch(*s) {
10        case '-': sign = -1;
11        case '+': ++s;
12    }
13    n = 0;
14    while(isdigit(*s)) n = 10 * n + *s++ - '0';
15    return (sign * n);
16 }

```

File: ATOIB.C

```

1 #define NOCCARGC /* no argument count passing */
2 /*

```

(Continued on page 70)

HEATH...OSBORNE...KAYPRO...ANY CP/M*-80

Tired of 16-bit Snobbery?

C/NIX-80™

Brings
UNIX* Power to CP/M*-80

Features	Prices
Hierarchical Directories	C/NIX™-80 65\$
UNIX*-like Shell	Manual Only 20\$
I/O Redirection & Pipes	
On-Line Documentation	Specify Disk Format
GREP, CAT, LS, CHDIR, etc.	Requires 48K CP/M-80

C/Craft™, Attn: T. Taft
22 Downing Road, Lexington, MA 02173
(617) 862-8177

*UNIX is a trademark of Bell Laboratories
CP/M is a trademark of Digital Research

Circle no. 8 on reader service card.

SAL/80® and SAL/86™

do for assembly language what
RATFOR does for FORTRAN
but emits

OPTIMALLY DENSE code.

SAL/8X includes console I/O
primitives which trivialize the task of
writing complex interactive user
interfaces. Improves programmer
productivity by a factor of two and
program maintainability by an order
of magnitude.

Extensively documented, available
for all CP/M compatible disk formats.
SAL/80 version 2.1, \$59.00, requires
64K and MAC or RMAC.

CALIFORNIA RESIDENTS ADD 6% SALES TAX.

PROTOOLS®

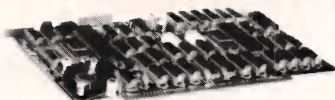
"Software Tools for the Professional"

24225 Summerhill Avenue
Los Altos, CA 94022
(415) 948-8007

Circle no. 55 on reader service card.

80 CHARACTER VIDEO BOARD

- WORDSTAR/dBASE II OPTION
- TYPE AHEAD KEYBOARD BUFFER



- 25 LINE NON-SCROLL OPTION
- Z80 CPU and 8275 CRTS S-100
- CHARACTER GRAPHICS
- ADAPTABLE SOFTWARE
- ORDER ASSEMBLED & TESTED OR
PRE-SOLDERED (ADD YOUR IC's)

VDB - A2 bare board from \$49.50

Simpliway PRODUCTS CO.
(312-359-7337)

P.O. BOX 601, Hoffman Estates, IL 60195
add \$3.00 S&H, 3% for Visa or Mastercard
Illinois Res. Add 6% Sales Tax
WORDSTAR is a trademark of MicroPro INTERN'L CORP.
dBASE is a trademark of ASHTON-TATE CORP.

Circle no. 65 on reader service card.

THE JOURNAL OF FORTH APPLICATION AND RESEARCH

Vol. 2, 1984:

**Forth Machines; 64K + Addressing;
Image Processing; Astronomy.**

Subscriptions

Corporate/Institutional \$100.
Individual \$40.

Back issues: Vol. 1, 1983,
Robotics; Data Structures. \$30.

Outside N. America add airmail:
Vol. 2 \$20, Vol. 1 \$10.

Checks in US funds on a US bank
payable to:

Journal of Forth Application & Research,
PO Box 27686, Rochester, NY 14627 USA.

A Publication of
The Institute for Applied Forth Research

Circle no. 31 on reader service card.

Real-World Applications

Are you interested in:

- Measurement and control?
- Hardware construction?
- Optoelectronics?
- Interfacing to external
devices?
- Low cost robotics?
- Stepper motors?
- EEPROMs?

The Computer Journal

is a magazine for those who interface,
build, and apply micros. Subscription
price \$24/year in the U.S. (12 issues).

PO Box 1697D Kallspell MT 59903

Circle no. 14 on reader service card.

CGRAPH DEVICE INDEPENDENT GRAPHICS SOFTWARE

- Vectors
- Character generator
- Windowing and clipping
- Re-entrant and re-interruptible
- Multiple simultaneous windows

Graphics programs independent of physi-
cal display, drives many displays at once.
Completely documented in clear English
with examples. Typical device drivers pro-
vided for hardware, including EPSON print-
ers. Shipped as **C SOURCE CODE** on 8"
SSSD CP/M or 5 1/4" MS-DOS disk. Specify
standard (K&R) or BDS C version. Ask for
availability for other operating systems or
media. Send check for \$49.95 to

Systems Guild Inc.
P.O. Box 1085, Cambridge, MA 02142
617-451-8479

Circle no. 73 on reader service card.



For S100 Bus Model 256KM

**256K/1MEG Byte Dynamic RAM
256K with 64K DRAMS \$759**

- 256K/1 mega Byte using 64K or 256K DRAMS •
- 8/16b Data • 24b Address • Parity per Byte • 175
- nsec Access Time • will run Z80/Z8000 to 8 mhz,
- 8086, 80186, 68000 to 8 mhz without wait states •
- transparent refresh, unlimited DMA.

Other Boards for S-100 Bus Available.

S.C. DIGITAL, INC.
1240 N. Highland Ave. Suite #4
Aurora, Illinois 60506
Phone: (312) 897-7749

Circle no. 62 on reader service card.



NEW version for 1984!

- Enables programs written for Digital Research
CP/M 2.2 to run under Cromemco CDOS and
vice versa. **INTRCEPT** release 3 automatically
recognizes the host system, and emulates
CP/M 2.2 if the host is CDOS, or emulates
CDOS if the host is CP/M 2.2.
- No programming, delivered ready-to-run.
- Customizable...comes with CDOS emulator
source, CP/M 2.2 emulator source optional.
- Z80 assembly language, no program or
operating system modifications.

\$150 w/CDOS emulator source
\$250 w/CDOS & CP/M emulator source

8" SSSD, inquire about 5 1/4"
add \$3 shipping, add 6% tax in CA
VISA, MC, check

PRO microSystems
16609 Sagewood Lane
Poway, California 92064
(619) 693-1022

Circle no. 54 on reader service card.

SMALL-C 2.0 for THE IBM PERSONAL COMPUTER and MS-DOS COMPATIBLE SYSTEMS

A large subset of C, packed from argo to
xtoi() with features, including

I/O redirection, compilation by parts, peephole optimization,
assembly language interface, conditional compilation,
switch/case/default, command line support, completion codes,
initialization of global variables, data types-char, int,
pointers, one-dimensional arrays, and externals

Complete source code for the compiler and
libraries plus a 22 page user manual are
included.

Requires:
IBM PC assembler, ASM.EXE, or equivalent
IBM PC-DOS 2.0, 2.1 or MS-DOS 2.0
96K memory and a SS Disk Drive

Send \$35 check or money order to

The Coriolis Company
P.O. Box 76
Clinton Corners, NY 12514
(NY residents please add 5% for sales tax.)

Executes sieve benchmark in 35 seconds!

Circle no. 17 on reader service card.

Micro-Math™ Only \$69

Mathematical programs for the 6800/6809/
8080/8085 (Z80 compatible) microprocessors.
Source code in standard assembler mnemon-
ics. These 8 1/2 x 11" program books include
full documentation and descriptions for:
Fixed/Floating Point Arithmetic, Data Con-
version/Manipulation, Square Root, Loga-
rithms, Exponentiation, Trigonometric/
Hyperbolic functions including inverses, and
more.

ORDER: *6800 (90 pages) \$39 + \$3 s/h
*transcendentals not included
6809 (530 pages) \$69 + \$5 s/h
8080 (580 pages) \$69 + \$5 s/h

Send check or money order. WA residents
must add 7.8% to base price.

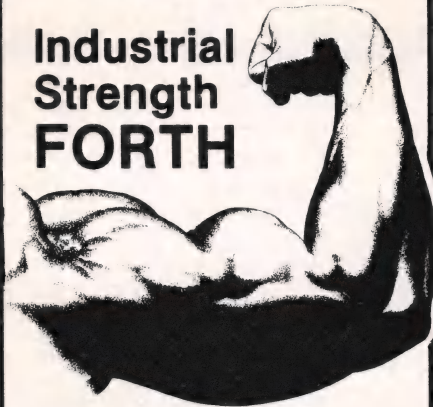
WANT MORE INFO: Send \$2 for 10-page brochure.

Micro-Math is distributed under copyright. Fee re-
quired for right to distribute Micro-Math based prod-
ucts in machine form.

F.N. Vitaljic Co.
514-13th St., Bellingham, WA 98225
(206) 733-3896

**Multiuser/Multitasking
for 8080, Z80, 8086**

Industrial Strength FORTH



TaskFORTH™

The First
Professional Quality
Full Feature FORTH
System at a micro price*

LOADS OF TIME SAVING PROFESSIONAL FEATURES:

- ☆ Unlimited number of tasks
- ☆ Multiple thread dictionary, superfast compilation
- ☆ Novice Programmer Protection Package™
- ☆ Diagnostic tools, quick and simple debugging
- ☆ Starting FORTH, FORTH-79, FORTH-83 compatible
- ☆ Screen and serial editor, easy program generation
- ☆ Hierarchical file system with data base management

* Starter package \$250. Full package \$395. Single user and commercial licenses available.

If you are an experienced FORTH programmer, this is the one you have been waiting for! If you are a beginning FORTH programmer, this will get you started right, and quickly too!

**Available on 8 inch disk
under CP/M 2.2 or greater
also
various 5¼" formats
and other operating systems**

**FULLY WARRANTIED,
DOCUMENTED AND
SUPPORTED**



DEALER
INQUIRES
INVITED



Shaw Laboratories, Ltd.
24301 Southland Drive, #216
Hayward, California 94545
(415) 276-5953

Small-C Library (Listing Continued, text begins on page 50) Listing Two

```

3 ** atoi(b,s,b) - Convert s to "unsigned" integer in base b.
4 **               NOTE: This is a non-standard function.
5 */
6 atoi(b,s, b) char *s; int b; {
7   int n, digit;
8   n = 0;
9   while(isspace(*s)) ++s;
10  while((digit = (127 & *s++)) >= '0') {
11    if(digit >= 'a')    digit -= 87;
12    else if(digit >= 'A') digit -= 55;
13    else                digit -= '0';
14    if(digit >= b) break;
15    n = b * n + digit;
16  }
17  return (n);
18 }
19

```

File: AUXBUF.C

```

1 #define NOCCARGC /* no argument count passing */
2 #include stdio.h
3 #include clib.def
4 extern int *_auxsz, *_auxef, _auxrd, _auxwt, _auxfl,
5           _status[];
6 /*
7 ** This module is loaded with a program only if auxbuf()
8 ** is called. It links to _open(), _read(), _write(), and
9 ** fflush() through _auxsz, _auxef, _auxrd, _auxwt, and _auxfl
10 ** in CSYSLIB. This technique reduces the overhead for
11 ** programs which don't use auxiliary buffering. Presumably,
12 ** if there is enough memory for extra buffering, there is
13 ** room to spare for this overhead too. A bug in some
14 ** versions of Small-C between 2.0 and 2.1 may cause the calls
15 ** to _auxrd, _auxwt, and _auxfl in _read(), _write(), and
16 ** fflush(), respectively, to produce bad code. The current
17 ** compiler corrects the problem.
18 */
19 int
20   _xsize[MAXFILES], /* size of buffer */
21   _xaddr[MAXFILES], /* aux buffer address */
22   _xnext[MAXFILES], /* address of next byte in buffer */
23   _xend[MAXFILES],  /* address of end-of-data in buffer */
24   _xeof[MAXFILES];  /* true if current buffer ends file */
25 /*
26 ** auxbuf -- allocate an auxiliary input buffer for fd
27 **   fd = file descriptor of an open file
28 ** size = size of buffer to be allocated
29 ** Returns NULL on success, else ERR.
30 ** Note: Ungetc() still works.
31 **   A 2nd call returns ERR, but has no effect.
32 **   If fd is a device, buffer is allocated but ignored.
33 **   Buffer stays allocated when fd is closed.
34 **   Do not mix reads and writes or perform seeks on fd.
35 */
36 auxbuf(fd, size) int fd; char *size; { /* fake unsigned */
37   if(!_mode(fd) || !size || avail(NO) < size || _xsize[fd])
38     return (ERR);

```



```

39 _xaddr[fd] = _xnext[fd] = _xend[fd] = malloc(size);
40 _auxef = _xeof; /* tell _open() where _xeof[] is */
41 _auxrd = _xread; /* tell _read() where _xread() is */
42 _auxwt = _xwrite; /* tell _write() where _xwrite() is */
43 _auxsz = _xsize; /* tell both where _xsize[] is */
44 _auxfl = _xflush; /* tell fflush() where _xflush() is */
45 _xsize[fd] = size; /* tell _read() that fd has aux buf */
46 return (NULL);
47 }
48
49 /*
50 ** Fill buffer if necessary, and return next byte.
51 */
52 _xread(fd) int fd; {
53 char *ptr;
54 while(YES) {
55 ptr = _xnext[fd];
56 if(ptr < _xend[fd]) {++_xnext[fd]; return (*ptr);}
57 if(!_xeof[fd]) {_seteof(fd); return (EOF);}
58 _auxsz = NULL; /* avoid recursive loop */
59 _xend[fd] = _xaddr[fd]
60 + read(fd, _xnext[fd]=_xaddr[fd], _xsize[fd]);
61 _auxsz = _xsize; /* restore _auxsz */
62 if(!feof(fd)) {_xeof[fd] = YES; _clreof(fd);}
63 }
64 }
65


```

```

66 /*
67 ** Empty buffer if necessary, and store ch in buffer.
68 */
69 _xwrite(ch, fd) int ch, fd; {
70 char *ptr;
71 while(YES) {
72 ptr = _xnext[fd];
73 if(ptr < (_xaddr[fd] + _xsize[fd]))
74 {*ptr = ch; ++_xnext[fd]; return (ch);}
75 if(!_xflush(fd)) return (EOF);
76 }
77 }
78
79 /*
80 ** Flush aux buffer to file.
81 */
82 _xflush(fd) int fd; {
83 int i, j;
84 i = _xnext[fd] - _xaddr[fd];
85 _auxsz = NULL; /* avoid recursive loop */
86 j = write(fd, _xnext[fd]=_xaddr[fd], i);
87 _auxsz = _xsize; /* restore _auxsz */
88 if(i != j) return (EOF);
89 return (NULL);
90 }

```

(Continued on next page)

		COMPUTER RESOURCES <small>of WAIMEA</small>	
<p align="center">*** EASY TO USE ***</p> <p align="center">Macro Programs for</p>			
		<p align="center">and</p>	
<p>We have been using and working with Spellbinder (Eaglewriter) on the Eagle Computers since late 1981. Our primary business is Real Estate investment and development. We use computers extensively in the day-to-day operation of our business and have developed a number of programs which we find useful. We recently formed a software development and marketing company - Computer Resources of Waimea, to promote and market these programs, most being enhancements and macro programs running under Spellbinder. Spellbinder's macro programming language M-Speak is extremely versatile and in our opinion is one of the best kept "secrets" in the world of micro computers. We have a number of macro programs for the end user, a number of utilities for the programmer, and for those who want a more or less organized instruction set for M-Speak, our head programmer has compiled his personal notes into a booklet which the M-Speak user should find very useful. It can be purchased for \$10.00. Send for our complete listing.</p>			
<p align="center">P.O. Box 1206 Kamuela, Hawaii 96743</p> <p align="center">(808) 885-7905</p>			

Circle no. 16 on reader service card.

<h2 align="center">CP/M[®] Software</h2>	
<p>A>DBPACK: Data base management; indexing, sort/search, tabulation, address labels ...</p> <p>A>DBPACK-II: Advanced data management; payroll, inventory, large & complex data bases ...</p> <p>A>COMCOM: Communication program; powerful, yet easy to use.</p> <p>A>CPMCPM: Transfer files (any type) between CP/M computers.</p> <p>A>FILER: Compresses, archives, catalogs & organizes files.</p> <p>A>UNERA: Recovers erased files.</p> <p>A>MULTED: Multi-file text editor.</p>	
<p align="center">CP/M is a registered trademark of Digital Research</p>	
<p align="center">Configured for a wide variety of systems. Disk formats include 8-inch, Osborne, Xerox ...</p>	
<p>Call or write for information</p>	<div align="center"> <p>COMPU-DRAW 1227 Goler House Rochester, NY 14620 Phone: (716)-454-3188</p> </div> <p>Dealer inquiries invited</p>
<p align="center">MasterCard, Visa & American Express cards welcome. Separately ordered documentation may be returned for full refund within 10 days!</p>	
<p align="center">It's the writing on the wall</p>	

Circle no. 10 on reader service card.

Small-C Library (Listing Continued, text begins on page 50)

Listing Two

File: AVAIL.C

```
1 #define NOCCARGC /* no argument count passing */
2 extern char *_memptr;
3 /*
4 ** Return the number of bytes of available memory.
5 ** In case of a stack overflow condition, if 'abort'
6 ** is non-zero the program aborts with an 'S' clue,
7 ** otherwise zero is returned.
8 */
9 avail(abort) int abort; {
10     char x;
11     if(&x < _memptr) {
12         if(abort) exit('M');
13         return (0);
14     }
15     return (&x - _memptr);
16 }
17
```

File: CALLOC.C

```
1 #define NOCCARGC /* no argument count passing */
2 #include stdio.h
```

```
3 /*
4 ** Cleared-memory allocation of n items of size bytes.
5 ** n      = Number of items to allocate space for.
6 ** size   = Size of the items in bytes.
7 ** Returns the address of the allocated block,
8 ** else NULL for failure.
9 */
10 calloc(n, size) char *n, *size; {
11     return (_alloc(n*size, YES));
12 }
```

File: CLEARERR.C

```
1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 extern int _status[];
5 /*
6 ** Clear error status for fd.
7 */
8 clearerr(fd) int fd; {
9     if(_mode(fd)) _status[fd] &= ~ERRBIT;
```

BDS C

The *fastest* CP/M-80 C
compiler available today

Version 1.5 contains some nifty improvements:

The unscrambled, *comprehensive* new User's Guide comes complete with tutorials, hints, error message explanations and an index.

The CDB symbolic debugger is a valuable new tool, written in C and included in *source form*. Debug with it, and *learn* from it.

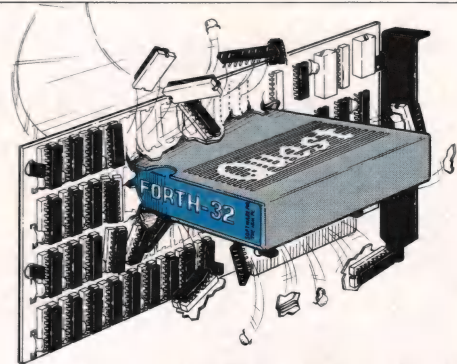
Hard disk users: You can finally organize your file directories sensibly. During compilation, take advantage of the new path searching ability for all compiler/linker system files. And at run-time, the enhanced file I/O mechanism recognizes user numbers as part of simple filenames, so you can manipulate files located *anywhere* on your system.

BDS C's powerful original features include dynamic overlays, full library and run-time package source code (to allow customized run-time environments, such as for execution in ROM), plenty of both utilitarian and recreational sample programs, and *speed*. BDS C takes less time to compile and link programs than any other C compiler around. And the execution speed of that compiled code is typically lightning fast, as the Sieve of Eratosthenes benchmark illustrates. (See the January 1983 BYTE, pg. 303).

BD Software
P.O. Box 9
Brighton, MA 02135
(617) 782-0836

8" SSD format, \$150
Free shipping on pre-paid orders
Call or write for availability on
other disk formats

Circle no. 3 on reader service card.



**Break Through the
64K Barrier!**

FORTH-32™ lets you use up to one megabyte of memory for programming. A Complete Development System! Fully Compatible Software and 8087 Floating Point Extensions.

Quest™
Quest Research, Inc.

303 Williams Ave.
Huntsville, AL 35801
(205) 533-9405

Call today toll-free or
contact a participating
Computerland store.

800-558-8088

Now available for the IBM PC, PC-XT, COMPAQ, COLUMBIA MPC,
and other PC compatibles!

IBM, COMPAQ, MPC, and FORTH-32 are trademarks of IBM, COMPAQ, Columbia Data Products, and Quest Research, respectively.

Circle no. 57 on reader service card.


```

10 }
11

```

File: CSEEK.C

```

1 #define NOCCARGC /* no argument count passing */
2 #include stdio.h
3 #include clib.def
4 extern int _fcbptr[], _chrpos[], _nextc[];
5 /*
6 ** Position fd to the 128-byte record indicated by
7 ** "offset" relative to the point indicated by "base."
8 **
9 **      BASE      OFFSET-RELATIVE-TO
10 **      0         first record
11 **      1         current record
12 **      2         end of file (last record + 1)
13 **
14 ** Returns NULL on success, else EOF.
15 */
16 cseek(fd, offset, base) int fd, offset, base; {
17     int oldrrn, *rrn;
18     if(!_mode(fd) || isatty(fd) || fflush(fd)) return (EOF);
19     rrn = _fcbptr[fd] + RRNOFF;
20     oldrrn = *rrn;
21     switch (base) {
22         case 2: _bdos(POSEND, _fcbptr[fd]);
23         case 1: *rrn += offset;
24                 break;
25         case 0: *rrn = offset;
26                 break;
27         default: return (EOF);
28     }
29     if(_sector(fd, RDRND)) {
30         *rrn = oldrrn;
31         return (EOF);
32     }
33     _chrpos[fd] = 0;
34     _nextc[fd] = EOF;
35     _clreof(fd);
36     return (NULL);
37 }
38

```

File: CTELL.C

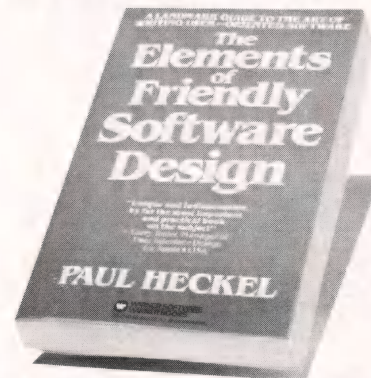
```

1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 extern int _fcbptr[], _chrpos[];
5 /*
6 ** Return offset to current 128-byte record.
7 */
8 ctell(fd) int fd; {
9     int *rrn;
10    if(!_mode(fd) || isatty(fd)) return (-1);
11    rrn = _fcbptr[fd] + RRNOFF;
12    return (*rrn);
13 }
14 /*
15 ** Return offset to next character in current buffer.
16 */
17 ctellc(fd) int fd; {

```

(Continued on next page)

Everyone from Commodore to IBM User Will Want This Remarkable Guide to Creating User-Oriented Software



Paul Heckel feels that to be "friendly," software should be visual, interactive, and above all, *communicative*. He first summons up the techniques of the great masters of communication in film, and of painters like Pablo Picasso and writers like Mark Twain. He then adds techniques of his own developed through years of successful software design, including programs for the Craig Language Translator and the all-new Viewdex™ system for the Epson HX-20. The result is a free-wheeling guide that is as delightful and surprising to read as it is easy and practical to use.

The Elements of Friendly Software Design explains:

- The thirty principles of friendly software design
- How filmmakers' communication techniques can be used to make software design "friendly"
- Visual thinking as a key to design
- Planning for prototyping and revision
- Factors that determine user acceptance
- Examples of excellence—why VisiCalc is so successful
- Seven traps that snag even the most experienced designers

"Unique and indispensable; by far the most important and practical book on the subject"

—Larry Tesler, Manager, User Interface Design, Apple's Lisa

Now In Quality Paperback

WARNER SOFTWARE
WARNER BOOKS

A Warner Communications Company

To order, send check or money order for \$10.20 in U.S.A. or \$12.00 in Canada (includes postage and handling) to Dept. PAA-X38-040, DD Warner Books, 666 Fifth Avenue, New York, NY 10103. Please allow four to six weeks for delivery.

Circle no. 79 on reader service card.

LYNX

the professional's replacement
for Microsoft L80

lynx



LYNX™ DOES

EVERYTHING L80™ DOES AND MORE!

LYNX™ LETS YOU USE ALL AVAILABLE MEMORY.

You can create COM files that are 10K larger—without overlays—by replacing L80 with LYNX.

LYNX™ IS A FULL OVERLAY LINKER

Running twice as fast as its nearest competitor, LYNX is tree structured, multi-segmented and multi-leveled, with automatic or explicit overlay invocation. You can run programs that are larger than available memory.

LYNX™ HAS BEEN HELPING MICROSOFT FORTRAN PROGRAMMERS FOR YEARS—NOW IT IS ALSO AVAILABLE FOR MICROSOFT BASIC AND AZTEC C.™

LYNX™ IS A QUALITY PRODUCT from the same company who offers you:

- GrafTalk, the business graphics package for Micros
- GRAPHICS development tools
- 2780/3780, 3270, X.25 communications
- MICRO TO MICRO communications



2730 High Ridge Road
Stamford, CT 06903
(203) 329-8874/Telex. 643351

\$250

LYNX and GrafTalk are trademarks of Redding Group, Inc. L80 is a trademark of Microsoft. AZTEC C is a trademark of MANX Software Systems.

Small-C Library Listing Two

(Listing Continued, text begins on page 50)

```
18 return (_chrpos[fd]);
19 }
20
```

File: DTOI.C

```
1 #define NOCCARGC /* no argument count passing */
2 #include <stdio.h>
3 /*
4 ** dtoi -- convert signed decimal string to integer nbr
5 ** returns field length, else ERR on error
6 */
7 dtoi(decstr, nbr) char *decstr; int *nbr; {
8 int len, s;
9 if((*decstr)=='-') {s=1; ++decstr;} else s=0;
10 if((len=atoi(decstr, nbr))<0) return ERR;
11 if(*nbr<0) return ERR;
12 if(s) (*nbr = -*nbr; return ++len;} else return len;
13 }
```

File: EXIT.C

```
1 #define NOCCARGC /* no argument count passing */
2 #include <stdio.h>
3 #include <clib.def>
4 /*
5 ** Close all open files and exit to CP/M.
6 ** Entry: errcode = Character to be sent to stderr.
7 ** Returns to CP/M rather than the caller.
8 */
9 exit(errcode) char errcode; {
10 int fd;
11 if(errcode) _conout(errcode);
12 for(fd=0; fd < MAXFILES; fclose(fd++));
13 _bdos(GDCPM,NULL);
14 }
15 #asm
16 abort equ exit
17 entry abort
18 #endasm
```

File: FCLOSE.C

```
1 #define NOCCARGC /* no argument count passing */
2 #include <stdio.h>
3 #include <clib.def>
4 /*
5 ** Close fd
6 ** Entry: fd = File descriptor for file to be closed.
7 ** Returns NULL for success, otherwise ERR
8 */
9 extern int _fcbptr[], _status[], _device[];
10 fclose(fd) int fd; {
11 if(!_mode(fd)) return (ERR);
12 if(!isatty(fd)) {
13 if(!flush(fd) || _bdos(CLOFIL, _fcbptr[fd])==255)
```



```

14     return (ERR);
15 }
16 return (_status[fd]=_device[fd]=NULL);
17 }
18

```

File: FEOF.C

```

1 #define NOCCARGC /* no argument count passing */
2 #include clib.def
3 extern int _status[];
4 /*
5 ** Test for end-of-file status.
6 ** Entry: fd = file descriptor
7 ** Returns non-zero if fd is at eof, else zero.
8 */
9 feof(fd) int fd; {
10     return (_status[fd] & EOFBIT);
11 }
12

```

File: FERROR.C

```

1 #define NOCCARGC /* no argument count passing */
2 #include stdio.h
3 #include clib.def
4 extern int _dirty[], *_auxsz, _auxfl;
5 /*
6 ** Write buffer for fd if it has changes.

```

```

7 */
8 ferror(fd) int fd; {
9     return (_status[fd] & ERRBIT);
10 }

```

File: FFLUSH.C

```

1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 extern _status[];
5 /*
6 ** Test for error status on fd.
7 ** Entry: fd = File descriptor of pertinent file.
8 ** Returns NULL on success, otherwise EOF.
9 */
10 fflush(fd) int fd; {
11     if(!_mode(fd)) return (ERR);
12     if(!_auxsz && _auxsz[fd] && _auxfl(fd)) return (ERR);
13     if(!_isatty(fd) && _dirty[fd] && _sector(fd, WRTRND)) {
14         _seterr(fd);
15         return (ERR);
16     }
17     return (NULL);
18 }
19

```

(Continued on next page)

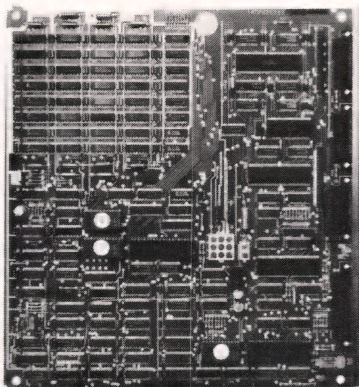
Z80* SINGLE BOARD COMPUTER!

64K RAM — 80 x 24 VIDEO DISPLAY — FLOPPY DISK CONTROLLER
RUNS CP/M* 2.2!

**BRAND NEW
PC BOARDS
WITH SCHEMATICS!**

**BOARD MEASURES
11½" x 12½"**

**ALL ORDERS WILL BE
PROCESSED ON A STRICT,
FIRST COME, FIRST SERVED
BASIS! ORDER EARLY!**



\$29.95
(BLANK BOARD WITH
DATA AND ROM'S.)

**NEW
PRICE**

**GROUP SPECIAL:
BUY 6 FOR \$165!**

**USES EASY
TO GET PARTS!**

UNBELIEVABLE LOW PRICE!!! GIANT COMPUTER MANUFACTURER'S SURPLUS!

Recently Xerox Corp. changed designs on their popular 820* computer. These prime, new, 820-1 PC boards were declared as surplus and sold. Their loss is your gain! These boards are 4 layers for lower noise, are solder masked, and have a silk screened component legend. They are absolutely some of the best quality PC boards we have seen, and all have passed final vendor QC. Please note, however, these surplus boards were sold by Xerox to us on an AS IS basis and they will not warrantly nor support this part.

We provide complete schematics, ROM'S, and parts lists. If you are an *EXPERIENCED* computer hacker, this board is for you! Remember, these are prime, unused PC boards! But since we have no control over the quality of parts used to populate the blank board, we must sell these boards as is, without warranty. You will have to do any debugging, if necessary, yourself!

*CP/M TM OF DIGITAL RESEARCH INC. (CALIF.) 820 TM OF XEROX CORP. Z80 TM OF ZILOG

WE ALSO CARRY LS, Z-80, EPROM'S, ETC. SEND FOR FREE CATALOG!

ADD \$2 PER PC BOARD FOR SHIPPING. (USA and Canada)

B. G. MICRO

P. O. Box 280298 Dallas, Texas 75228
(214) 271-5546



TERMS: Orders over \$50 add 85¢ insurance. No COD. Tex. Res. Add 6% Sales Tax. Subject to prior sale. Foreign orders: US funds only. We cannot ship to Mexico. Foreign countries other than Canada add \$6 per board shipping.

Circle no. 4 on reader service card.

Listing Two

File: FGETC.C

```
1 #define NOCCARGC /* no argument count passing */
2 #include stdio.h
3 #include clib.def
4 extern int _chrpos[];
5 /*
6 ** Character-stream input of one character from fd.
7 ** Entry: fd = File descriptor of pertinent file.
8 ** Returns the next character on success, else EOF.
9 */
10 fgetc(fd) int fd; {
11     int ch;
12     while(1) {
13         switch(ch = _read(fd)) {
14             default: return (ch);
15             case CPMEOF: switch(_chrpos[fd]) {
16                 default: --_chrpos[fd];
17                 case 0:
18                 case BUFSIZE:
19                     }
20                 _seteof(fd);
21                 return (EOF);
22             case CR: return ('\n');
23             case LF: /* NOTE: _conin() maps LF -> CR */
24                 }
25         }
26     }
27 #asm
28 getc equ fgetc
29 entry getc
30 #endasm
31
```

File: FGETS.C

```
1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 /*
5 ** Gets an entire string (including its newline
6 ** terminator) or size-1 characters, whichever comes
7 ** first. The input is terminated by a null character.
8 ** Entry: str = Pointer to destination buffer.
9 ** size = Size of the destination buffer.
10 ** fd = File descriptor of pertinent file.
11 ** Returns str on success, else NULL.
12 */
13 fgets(str, size, fd) char *str; int size, fd; {
14     return (_gets(str, size, fd, 1));
15 }
16
17 /*
18 ** Gets an entire string from stdin (excluding its newline
19 ** terminator) or size-1 characters, whichever comes
20 ** first. The input is terminated by a null character.
```

```
21 ** The user buffer must be large enough to hold the data.
22 ** Entry: str = Pointer to destination buffer.
23 ** Returns str on success, else NULL.
24 */
25 gets(str) char *str; {
26     return (_gets(str, 32767, stdin, 0));
27 }
28
29 _gets(str, size, fd, nl) char *str; int size, fd, nl; {
30     int backup;
31     char *next;
32     next = str;
33     while(--size > 0) {
34         switch (*next = fgetc(fd)) {
35             case EOF: *next = NULL;
36                 if(next == str) return (NULL);
37                 return (str);
38             case '\n': *(next + nl) = NULL;
39                 return (str);
40             case RUB: if(next > str) backup = 1; else backup = 0;
41                 goto backout;
42             case WIPE: backup = next - str;
43                 backout:
44                     if(iscons(fd)) {
45                         fputs("\b\b\b", stderr);
46                         ++size;
47                         while(backup--) {
48                             fputs("\b", stderr);
49                             if(*--next < 32) fputs("\b\b", stderr);
50                             ++size;
51                         }
52                         continue;
53                     }
54                     default: ++next;
55                 }
56     }
57     *next = NULL;
58     return (str);
59 }
60
```

File: FOPEN.C

```
1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 /*
5 ** Open file indicated by fn.
6 ** Entry: fn = Null-terminated CP/M file name.
7 ** May be prefixed by letter of dirve.
8 ** May be just CON:, RDR:, PUN:, or LST:.
9 ** mode = "a" - append
10 ** "r" - read
11 ** "w" - write
12 ** "a+" - append update
```

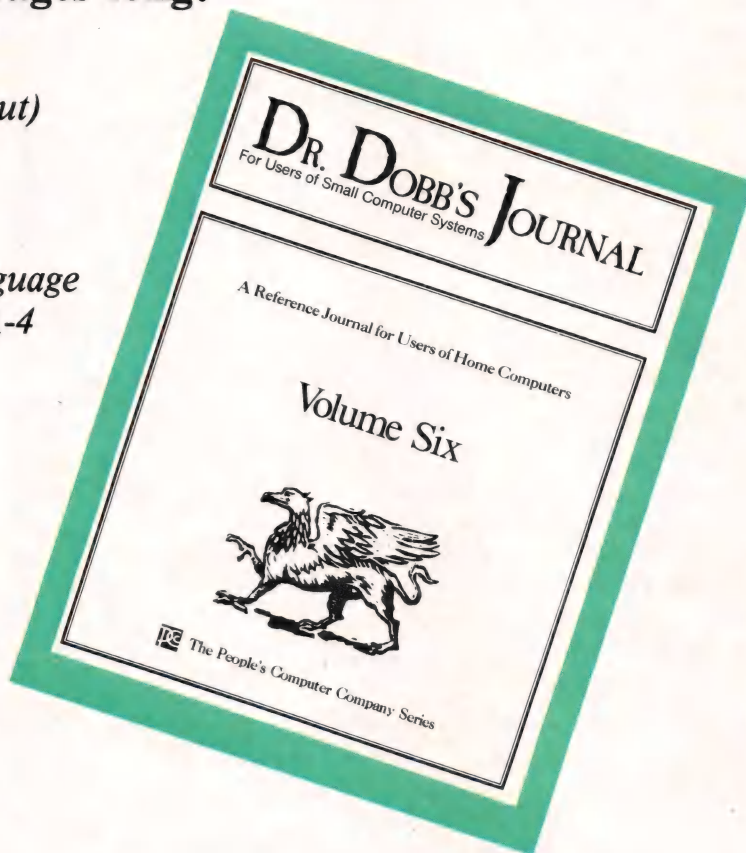
(Continued on page 78)

Volume 6

Now Available!

At last what you've been waiting for: ALL the issues from 1981 in one GIANT volume—over 550 pages long!

- *The first all-FORTH issue (now sold out)*
- *More Small-C development*
- *Continuing coverage of CP/M*
- *Santa Barbara Tiny BASIC for 6809*
- *Pidgin - A Systems Programming Language*
- *Write Your Own Compiler with META-4*
- *The first "Clinic" columns*
- *The Electric Phone Book*
- *J.E. Hendrix's Small-VM*
- *What FORTH Is?*
- *Several exciting Z80 utilities*
- *The Conference Tree*
- *PCNET information*
- *Several North Star tidbits*
- *An assortment of utilities*
- *And much, much more*



YES! ☐ Please send me the following Volumes of Dr. Dobb's Journal.
☐ ALL 6 for ONLY \$125, a savings of over 15%

Signature _____

Name _____

Address _____

City _____ State _____ Zip _____

Card# _____ Expiration Date _____

Please charge my:

- ☐ Visa ☐ American Express
☐ MasterCard ☐ I enclose ☐ Check/Money order

**This offer expires
September 31, 1984.**

*These are reduced prices
for Dr. Dobb's readers.*

Vol. 1	_____	×	\$23.75	=	_____
Vol. 2	_____	×	\$23.75	=	_____
Vol. 3	_____	×	\$23.75	=	_____
Vol. 4	_____	×	\$23.75	=	_____
Vol. 5	_____	×	\$23.75	=	_____
Vol. 6	_____	×	\$27.75	=	_____
All 6	_____	×	\$125.	=	_____
Subtotal	_____				

Postage and Handling _____

Must be included with order.

*Please add \$1.25 per book in U.S.
(\$2.00 each outside U.S.)*

MAIL TO: Dr. Dobb's Journal 2464 Embarcadero Way, Palo Alto, CA, 94303

V3 TOTAL _____

Small-C Library (Listing Continued, text begins on page 50)

Listing Two

```
13 **          "r+" - read  update
14 **          "w+" - write update
15 ** Returns a file descriptor on success, else NULL.
16 */
17 fopen(fn, mode) char *fn, *mode; {
18     int fd;
19     fd = 0; /* skip stdin (= error return) */
20     while(++fd < MAXFILES) {
21         if(_mode(fd) == NULL) {
22             if(_open(fn, mode, fd) != ERR) return (fd);
23             break;
24         }
25     }
26     return (NULL);
27 }
28
```

File: FPRINTF.C

```
1 #define NOCCARGC
2 /*
3 ** Yes, that is correct.  Although these functions use an
4 ** argument count, they do not call functions which need one.
5 */
6 #include stdio.h
7 /*
8 ** fprintf(fd, ctlstring, arg, arg, ...) - Formatted print.
9 ** Operates as described by Kernighan & Ritchie.
10 ** b, c, d, o, s, u, and x specifications are supported.
11 ** Note: b (binary) is a non-standard extension.
12 */
13 fprintf(argc) int argc; {
14     int *nxtarg;
15     nxtarg = CCARGC() + &argc;
16     return(_print(++nxtarg, --nxtarg));
17 }
18
19 /*
20 ** printf(ctlstring, arg, arg, ...) - Formatted print.
21 ** Operates as described by Kernighan & Ritchie.
22 ** b, c, d, o, s, u, and x specifications are supported.
23 ** Note: b (binary) is a non-standard extension.
24 */
25 printf(argc) int argc; {
26     return(_print(stdout, CCARGC() + &argc - 1));
27 }
28
29 /*
30 ** _print(fd, ctlstring, arg, arg, ...)
31 ** Called by fprintf() and printf().
32 */
33 _print(fd, nxtarg) int fd, *nxtarg; {
34     int arg, left, pad, cc, len, maxchr, width;
35     char *ctl, *sptr, str[17];
36     cc = 0;
37     ctl = *nxtarg--;
```

```
38 while(*ctl) {
39     if(*ctl != 'X') {fputc(*ctl++, fd); ++cc; continue;}
40     else ++ctl;
41     if(*ctl == 'Z') {fputc(*ctl++, fd); ++cc; continue;}
42     if(*ctl == '-') {left = 1; ++ctl;} else left = 0;
43     if(*ctl == '0') pad = '0'; else pad = ' ';
44     if(isdigit(*ctl)) {
45         width = atoi(ctl++);
46         while(isdigit(*ctl)) ++ctl;
47     }
48     else width = 0;
49     if(*ctl == '.') {
50         maxchr = atoi(++ctl);
51         while(isdigit(*ctl)) ++ctl;
52     }
53     else maxchr = 0;
54     arg = *nxtarg--;
55     sptr = str;
56     switch(*ctl++) {
57         case 'c': str[0] = arg; str[1] = NULL; break;
58         case 's': sptr = arg; break;
59         case 'd': itoa(arg, str); break;
60         case 'b': itoab(arg, str, 2); break;
61         case 'o': itoab(arg, str, 8); break;
62         case 'u': itoab(arg, str, 10); break;
63         case 'x': itoab(arg, str, 16); break;
64         default: return (cc);
65     }
66     len = strlen(sptr);
67     if(maxchr && maxchr < len) len = maxchr;
68     if(width > len) width = width - len; else width = 0;
69     if(!left) while(width--) {fputc(pad, fd); ++cc;}
70     while(len--) {fputc(*sptr++, fd); ++cc;}
71     if(left) while(width--) {fputc(pad, fd); ++cc;}
72 }
73 return(cc);
74 }
75
```

File: FPUTC.C

```
1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 extern int _status[];
5 /*
6 ** Character-stream output of a character to fd.
7 ** Entry: ch = Character to write.
8 **          fd = File descriptor of pertinent file.
9 ** Returns character written on success, else EOF.
10 */
11 fputc(ch, fd) int ch, fd; {
12     switch(ch) {
13         case EOF: _write(CPMEOF, fd); break;
```

(Continued on page 80)

Changing Your Address?

Staple your label here.

To change your address, attach your address label from the cover of the magazine to this coupon and indicate your new address below.

Name _____

Address _____

Address _____

Apt. # _____

City _____

State _____

Zip _____

Mail to: DDJ, 2464 Embarcadero Way, Palo Alto, CA 94303

Circle no. 85 on reader service card.

CDE SOFTWARE

DISK FORMAT CONVERSION SERVICES

CDE now offers disk conversions from one format to another. We can even convert text files from MS-DOS to CP/M and back.

The cost? Only \$7.00 per disk, and we supply the destination disk! (\$5.00 if you supply the disk.) Additional copies of the same disk are only \$5.00 each (\$3.50 on your disk). If a second disk is required to hold down-loaded data, it is \$2.00 additional. VISA and MasterCard accepted.

Formats available include 8" SSSD and the following 5" formats:

Kaypro	ACCESS
Osborne	LOBO MAX-80
Xerox 820	TI Professional
TRS-80 mod-I (Omikron CP/M)	HP-125
TRS-80 mod-III (MM CP/M)	Televideo TS-802
IBM-PC for CP/M	Otrona
Morrow	IMS-5000
NEC PC-8001A	EPSON QX-10
Zenith Z-90	Sanyo
Heath with Magnolia	NEC PC-8801
Superbrain	Zenith Z-100
Cromemco	Datavue
DEC VT-180	MAGIC Computer

Write for our complete catalogue.

2463 McCready Avenue • Los Angeles, CA 90039

Circle no. 7 on reader service card.

GTEK INC. (601) 467-8048

EPROM PROGRAMMER

DEVELOPMENT HARDWARE/SOFTWARE
HIGH PERFORMANCE/ COST RATIO

Compatible w/all Rs 232 serial interface port * Auto select baud rate * With or without handshaking * Bidirectional Xon/Xoff and CTS/DTR supported * Read pin compatible ROMS * No personality modules * Intel, Motorola, MCS86, Hex formats * Split facility for 16 bit data paths * Read, program, formatted list commands * Interrupt driven, program and verify real time while sending data * Program single byte, block, or whole EPROM * Intelligent diagnostics discern bad and erasable EPROM * Verify erasure and compare commands * Busy light * Complete w/Textool zero insertion force socket and integral 120 VAC power (240 VAC/50Hz available)

DR Utility Package allows communication with 7128, 7228, and 7956 programmers from the CP/M command line. Source Code is provided. PGX utility package allows the same thing, but will also allow you to specify a range of addresses to send to the programmer. Verify, set the Eprom type.

MODEL 7316 PAL PROGRAMMER
Programs all series 20 PALS. Software included for compiling PAL source codes.

Software Available for CPM,¹ ISIS,² TRSDOS,³ MSDOS.⁴

1. TM of Digital Research Corp.
2. TM of Intel Corp.
3. TM of Tandy Corp.
4. TM of Microsoft.

Post Office Box 289
Waveland, Mississippi 39576
(601)-467-8048

Avocet Cross Assemblers are available to handle 8748, 8751, Z8, 6502, 680X, etc. Available for CP/M and MSDOS computers. Order by processor type and specify kind of computer.

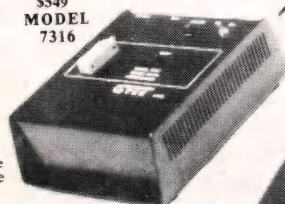
Model DE-4 U/V Products hold 8, 28 pin parts. High quality professional construction.

S879 stand alone
MODEL 7956

MODEL 7956
GANG PROGRAMMER

Intelligent algorithm. Stand alone, copies eight EPROMS at a time. With RS-232 option \$1099.

\$549
MODEL
7316



\$1195
MODEL
7324



MODEL 7324 PAL PROGRAMMER
Programs all series 20 & 24 PALS. Operates stand alone or via RS232.

\$549
MODEL
7228

MODEL 7228
EPROM PROGRAMMER

All features of Model 7128 plus Auto Select Baud, super fast adaptive programming algorithms, low profile aluminum enclosure. Programs 2764 in one minute!

\$429
MODEL
7128



MODEL 7128 EPROM PROGRAMMER
Programs and Read:

NMOS	NMOS	CMOS	EEPROM	MPU'S
2508	2758	27C16	5213	8748
2516	2716	27C32	5213H	8748H
2532	2732	C6716	X2816	8749H
2564	2732A	27C54	48016	8741
68766	2764		12816A	8742H
68764	27128			8741H
8755	27256			8751
5133				

Circle no. 28 on reader service card.



WHY FORTH ?

- Genuinely Interactive (BASIC is much less interactive)
- Encourages Modular Programs (inefficiency and cluttered syntax hamper effective modularization in compiled languages)
- Fast Execution (not even C is faster)
- Amazingly Compact Code
- Fast Program Development
- Easy Peripherals Interfacing

HS / FORTH

- Fully Optimized & Tested for:
IBM-PC IBM-XT IBM-JR
COMPAQ EAGLE-PC-2
TANDY 2000 LEADING EDGE
and all MSDOS compatibles
 - Graphics - line, rectangle, block
 - Music - foreground and background
 - Scaled decimal floating point
 - Includes Forth-79 and Forth-83
 - Full Support for DOS Files, Standard Screens and Random access DOS Screen Files
 - Full Use of 8088 Instructions (not limited 8080 conversion subset of transported versions)
 - Separate Segments for Code, Stack, Vocabularies, and Definition Lists - multiple sets possible
 - Segment Management Support
 - Full Megabyte - programs or data
 - Coprocessor Support
 - Multi-task, Multi-user Compatible
 - Automatic Optimizer (no assembler knowledge needed)
 - Full Assembler (interactive, easy to use & learn)
 - Compare - BYTE Sieve Benchmark jan83
HS/FORTH 47 sec BASIC 2000 sec
w/AUTOOPT 9 sec Assembler 5 sec
other Forths (mostly 64k) 70-140 sec
- PS You don't have to understand this ad to love programming in HS/FORTH!

HS/FORTH with AUTO-OPT & MICRO-ASM \$220.

 Visa  Mastercard
Add \$10. shipping and handling

HARVARD SOFTWORKS

PO BOX 339
HARVARD, MA 01451
(617) 456-3021

Small-C Library (Listing Continued, text begins on page 50) Listing Two

```

14 case '\n': _write(CR, fd); _write(LF, fd); break;
15 default: _write(ch, fd);
16 }
17 if(_status[fd] & ERRBIT) return (EOF);
18 return (ch);
19 }
20 #asm
21 putc equ fputc
22 entry putc
23 #endasm

```

File: FPUTS.C

```

1 #define NOCCARGC /* no arg count passing */
2 #include stdio.h
3 #include clib.def
4 /*
5 ** Write a string to fd.
6 ** Entry: string = Pointer to null-terminated string.
7 **      fd      = File descriptor of pertinent file.
8 */
9 fputs(string,fd) char *string; int fd; {
10 while(*string)
11     fputc(*string++,fd) ;
12 }
13

```

File: FREAD.C

```

1 #define NOCCARGC /* no argument count passing */
2 #include clib.def
3 extern int _status[];
4 /*
5 ** Item-stream read from fd.
6 ** Entry: buf = address of target buffer
7 **      sz = size of items in bytes
8 **      n = number of items to read
9 **      fd = file descriptor
10 ** Returns a count of the items actually read.
11 ** Use feof() and ferror() to determine file status.
12 */
13 fread(buf, sz, n, fd) char *buf; int sz, n, fd; {
14     return (read(fd, buf, n*sz));
15 }
16
17 /*
18 ** Binary-stream read from fd.
19 ** Entry: fd = file descriptor
20 **      buf = address of target buffer
21 **      n = number of bytes to read
22 ** Returns a count of the bytes actually read.
23 ** Use feof() and ferror() to determine file status.
24 */
25 read(fd, buf, n) int fd, n; char *buf; {
26     char *cnt; /* fake unsigned */
27     cnt = 0;
28     while(n--) {
29         *buf++ = _read(fd);

```



```

30  if(_status[fd] & (ERRBIT | EOFBIT)) break;
31  ++cnt;
32  }
33  return (cnt);
34  }

```

File: FREE.C

```

1 #define NOCCARGC /* no argument count passing */
2 extern char *_mempr;
3 /*
4 ** free(ptr) - Free previously allocated memory block.
5 ** Memory must be freed in the reverse order from which
6 ** it was allocated.
7 ** ptr = Value returned by calloc() or malloc().
8 ** Returns ptr if successful or NULL otherwise.
9 */
10 free(ptr) char *ptr; {
11  return (_mempr = ptr);
12 }
13 #asm
14 cfree equ free
15 entry cfree
16 #endasm

```

File: FREOPEN.C

```

1 #define NOCCARGC /* no argument count passing */
2 #include stdio.h
3 /*
4 ** Close previously opened fd and reopen it.
5 ** Entry: fn = Null-terminated CP/M file name.
6 **          May be prefixed by letter of drive.
7 **          May be just CON:, RDR:, PUN:, or LST:.
8 **          mode = "a" - append
9 **                "r" - read
10 **               "w" - write
11 **               "a+" - append update
12 **               "r+" - read update
13 **               "w+" - write update
14 **          fd = File descriptor of pertinent file.
15 ** Returns the original fd on success, else NULL.
16 */
17 freopen(fn, mode, fd) char *fn, *mode; int fd; {
18  if(fclose(fd)) return (NULL);
19  if(_open(fn, mode, fd)==ERR) return (NULL);
20  return (fd);
21 }

```

(To be Continued in June Issue)

FOR \$29.95, MICRO-WYL WILL WHEN OTHERS WON'T!

You'll know why INFOWORLD rated *Micro-WYL's* performance "Excellent" when you want to insert a file into a file; when you want to print directly from the screen; when you want to see what your text will look like before printing; set tabs where you want them; write programs the easy way; and do many other things that no other word processor can do. *Micro-WYL* is a line editor; use it in conjunction with EMACS derivative word processors and you have the best of all worlds! For \$29.95, plus \$2.00 postage and handling, have it your way! Sold with the usual Overbeek 30 day money-back guarantee.

LET *Micro-WYL* DO IT ALL TODAY!
Enclosed find check for \$31.95 or

charge my Mastercard# _____ Expires: _____

Visa# _____ Expires: _____

Check format desired:

<input type="checkbox"/> 8" SSD	<input type="checkbox"/> Osborne Single Density	<input type="checkbox"/> KayPro II
<input type="checkbox"/> Superbrain	<input type="checkbox"/> Osborne Double Density	<input type="checkbox"/> NEC 5"
<input type="checkbox"/> Northstar Advantage	<input type="checkbox"/> Morrow Micro Decision	<input type="checkbox"/> Televideo802
<input type="checkbox"/> Northstar Horizon	<input type="checkbox"/> Xerox 820 Single Density	<input type="checkbox"/> ALTOS 5
<input type="checkbox"/> Apple/Softcard	<input type="checkbox"/> Xerox 820 Double Density	<input type="checkbox"/> Epson

I'm not ready to order now, but send me information about all the affordable programs from Overbeek Enterprises.

Name _____
Address _____
City _____ State _____ Zip _____

OVERBEEK ENTERPRISES, P.O. Box 726D, Elgin, IL 60120
312-697-8420

Micro-WYL — another affordable program from Overbeek Enterprises.

Circle no. 47 on reader service card.

At Last! bds C... Ver. 1.5

Including a new dynamic debugger Still the choice of professionals

- Compiler option to generate special symbol table for new dynamic debugger by David Kirkland. (With the debugger, the distribution package now requires two disks.)
- Takes full advantage of CP/M® 2.x, including random-record read, seek relative to file end, user number prefixes, and better error reporting.

- Clink option to suppress warm-boot
- New library file search capabilities
- New, fully-indexed 180 page manual
- * CP/M is a trademark of Digital Research, Inc.

V 1.5 \$120.00
V 1.46 \$115.00
(needs only 1.4 CP/M)

Other C compilers and C related products available . . . Call!

TERMS: CHECK,
MONEY ORDER, C.O.D.,
CHARGE CARD
HOURS: 9 am—5 pm
Monday —Friday
(316) 431-0018

IT'S HERE!
MONEY MATH

- Uses BCD internal representation.
- You choose from two types of rounding.
- Configurable exception handling
- Distributed with 12 digits precision. Easily configured for more or less
- Excess 64 exponents

SOURCE INCLUDED \$5000



Dedicated Micro Systems, Inc.
P.O. Box 481, Chanute, Kansas 66720

include \$2.50 for postage and handling

Circle no. 23 on reader service card.

The Accent Finder

If you have ever taken an introductory Spanish or French course, you probably know what accents are. You remember: those little marks that had to be placed on top of certain letters in certain words just to make your life bitter. French has three kinds of accents; the rules for their placement are complicated and have many exceptions. Spanish has only one accent and a single placement rule with fewer exceptions. Nonetheless, things can get complicated.

If you want to write Spanish correctly, you have three choices:

1. Learn the accent placement rule and all the exceptions (time factor: 7 days)
2. Write with a dictionary by your side and look up each word (time factor: 1 minute per word)
3. Write a program that tells the user where to put the accent and teaches the user the rules and exceptions (time factor: who cares, as long as I get to play?)

I wrote the Accent Finder program as an exercise in the use of sets in Pascal and also for the benefit of UCLA students interested in using the computer for humanities. Members of the Spanish department thoroughly tested the Accent Finder, and so far it has not produced any erroneous output. Should you find an error, please contact me for changes. The UCLA IBM4341 User's Group keeps a version of this program on the school's open access computer for any interested users.

A Brief Primer of Spanish Phonology

Believe it or not, there is an academy (in Spain, naturally) that supervises the use and development of Spanish. This institution has formulated rules for the placement of the accent and for the correct parsing of words into syllables (which is crucial for our algorithm).

Spanish orthography is almost a mapping of the phonetics (i.e., each letter is a symbol for a unique sound; you write what you hear). The phonetic inventory consists of the vowels (A, E, I, O, U) and

a multitude of consonants more or less similar to English. There are also two liquids: L and R. These sounds are called liquids because of certain features (i.e., they can be held a long time, just like a vowel, and the sound-generating flow of air escapes on both sides of the tongue while it touches the palate). Vowels are strong (the set [A, E, O]) and nonstrong (the set [I, U]).

The Accent Placement Rule

For the purpose of placing accents, a Spanish word is described by two criteria:

1. The position of the syllable with the pronunciation emphasis
2. The quality of the last sound of the word

To decide whether an accent is needed, we apply each of the criteria to the word in question and compare the results.

Each criterion can mark a word with a plus or a minus. If the emphasis syllable is the penultimate one, then the word gets a plus; otherwise, the word gets a minus. If the word ends with a vowel, an N, or an S, then the word gets a plus from criterion 2; otherwise, the word gets a minus. If the word has two different signs (i.e., both plus and minus), then the word gets a written accent on the emphasis vowel. If the word has two identical signs, then no accent is required.

Let's look at an example. In the word *chicharon*, the syllables are:

1 CHI ** 2 CHA ** 3 RON

The emphasis is on syllable 3, not the penultimate one. Thus, criterion 1 marks the word with a minus. The last sound of the word is N. Thus, criterion 2 marks the word with a plus. The signs for *chicharon* are mixed, so you must place a written accent on the last syllable: *chicharón*.

Now let's look at *francesa*. The syllables are:

1 FRAN ** 2 CE ** 3 SA

The emphasis is on the penultimate syllable: the word gets a plus under criterion 1. The last sound is A, a vowel: the word gets another plus under criterion 2. The signs are the same, so no accent is required.

The Accent Placement Algorithm

The accent placement problem is now to find a way of coding the word description criteria (the emphasis position and the quality of the last sound). I chose to represent the criteria by means of two

Booleans: CountPlus, which is true when the emphasis is on the penultimate syllable, and EndPlus, which is true when the word ends with an N, an S, or a vowel.

The setting of EndPlus is trivial. First, define the variable vowels of type SET OF CHAR:

Vowels := ['A', 'E', 'I', 'O', 'U']

Next, check to see if the last character of the word is in the vowel set. If it is, then EndPlus is set to true.

The setting of CountPlus is more complicated. The word must first be split into syllables (we'll cover that shortly), and the position of the emphasis must then be identified.

I chose to identify the position of the emphasis by asking the user. This accomplishes two goals: the user thinks about the rule and the pronunciation, and words such as *mama*, which can take the emphasis on different syllables according to the syntactic role, are covered.

The Algorithm for Syllable Parsing

Splitting a word into syllables is a process that relies on our linguistic intuitions. However, a fairly simple set of rules can be drafted for automatic parsing. We need three arrays of Booleans parallel with the string holding the word: Strong, Vowel, and Boundary. Strong is true if the sound in the string is a strong vowel. Vowel is true if the sound is a vowel. Boundary is true if the sound at the same position in the string is the boundary between two syllables.

All we must do now is to set the values of the elements of the Boundary array. Boundary is set to true (i.e., the respective sound is a border between two syllables) in the following cases:

1. If the current sound is T and the previous sound was N
2. If the current sound is a vowel and the previous sound was a consonant
3. If the current sound is a nonstrong vowel and the previous sound was a strong vowel
4. If both the current and the previous sounds are vowels

All this is done in the SetSylls procedure via a FOR loop, which checks the qualities of each sound and its neighbor's. Each time the qualifying conditions are met, the element of the Boundary array at that position is set to true.

In the SetSylls procedure, a final check is executed. If the procedure finds

by Eddy Vasile

Eddy Vasile, 3314 Sawtelle Blvd. #28, Los Angeles, CA 90066.

the pattern vowel-consonant-consonant, then the Boundary is reset: the first consonant gets to be a boundary, and the second becomes part of the syllable initiated by the first. If the procedure encounters two neighboring consonants, then the second one marks a syllable boundary. One exception is LL, which in Spanish is pronounced like the English Y; this is coded in the procedure Split-Consonants, which checks for a consonant-consonant pattern (other than LL) by means of a FOR loop.

Two other consonant pairs should not be split: CH, which generates a single sound, just as its English counterpart, and liquids. The procedures WeldCH and Weld-

Liquids scan the CH and liquid patterns (using a FOR loop) and set the Boundary to true for the leading consonants.

Now that the syllable boundaries are set, we can concatenate all the letters marked false in the Boundary array to the letter marked true that precedes them, creating the bodies of the syllables that are kept in the Syllables array.

Program Output

The program displays the syllables with a delimiter between them and asks the user to pick the one with the emphasis. Next, the plus/minus rule is applied as described above; if the word has an accent, then it is displayed on the strong vowel of

the syllable with the emphasis. The program also explains its decisions as it goes along, using the procedure InfoMsg.

The program provides for extensive error checking for entry of incorrect alphanumeric symbols and incorrect syllable numbers. Special procedures also are included for words that get accents according to syntactic context.

■ ■ ■

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 196.

Accent Finder Listing

```
(*****
The Accent program analyzes spanish words and determines if and where
there is a written accent. The program will ask for the word and then
it will display the word split in syllables and it will ask for the
number of the syllable carrying the pronunciation emphasis. The
syllables are split by stars.
If there should be a written accent, then its position will
be displayed.
```

The algorithm has considerable error checking with the use of sets for bad input or bogus syllable numbers.

Author: Eddy C. Vasile
Last modified: Sept 15 83

NOTE: Please warn users that syllable parsing is sometimes disputed even in highly qualified linguistic circles. My parsing algorithm will produce a somewhat unorthodox syllable scheme when dealing with diphthongs, but only to suit the ultimate need of accent evaluation.

*****)

program accent;

const

MaxChar = 50; (*Maximum line size *)
MaxSyl = 10; (*Maximum number of syllables *)
SylSize = 5; (*Maximum size of a syllable *)
Radix = 10; (* base 10, used for conversions*)

type

CharSet = set of char;
WordType = string[MaxChar];
WordIndexType = 1..MaxChar;

var

Word :WordType; (*The word to be processed*)
Letters, (*The alphabet *)
LowerCaseSet, (*Lower case letters *)
Vowels,
StrongVowels,
Liquids :CharSet;
Error:boolean;

(Continued on next page)

Accent Finder Listing (Listing Continued, text begins on page 82)

```
(*****
* function NUMERIC
*   Given : 1-10 char token (InputStr)
*   Return : TRUE if it is a numeric constant.
*           FALSE if it is not.
*   If any char is non-numeric, the token is non-numeric.
*****)
function Numeric(InputStr : WordType): boolean;
  var
    i      : WordIndexType;      (* pos. chars of input string *)
  begin (* Numeric *)
    Numeric := TRUE;              (* return TRUE by default *)
    for i := 1 to length(InputStr) do (* if any chars are *)
      if not (InputStr[i] in ['0'..'9']) (* non-numeric, *)
        then Numeric := FALSE          (* return FALSE *)
    end; (* Numeric *)

(*****
* function CONVERT
*   Given : a string of digits (InString).
*   Return : its value (integer).
*   Convert from string to numeric by multiplying each digit by the
*   appropriate power of the specified base (Radix).
*****)
function Convert(InString:WordType):integer;
  var
    Temp : Integer;
    i     : WordIndexType;      (* poses chars of input string *)
  (*****
  * The DigValue function returns the numeric value of a single digit*
  *****)
function DigValue (c:char):integer;
  begin
    DigValue:=ord(c)-ord('0')
  end;

  begin (* Convert *)
    Temp:=0;                      (* initially return value = 0 *)

    (* Beginning with left-most digit, multiply its value by the *
    * specified base and add result to previous value.           *)
    if length(InString) > 0 then
      begin
        Temp:=DigValue(InString[i]);
        for i:=2 to length(InString) do
          Temp:=Temp * Radix + DigValue(InString[i])
        end (*if*)
      end; (* Convert *)

(*****
* The condense procedure preprocesses the input*
* word by compressing it and trimming both ends*
* If your compiler does not have these
* you may either ignore this proc or write the
* functions your self.
*****)
```



```

function Condense(Instring:WordType):WordType;
begin
    Condense:=compress(ltrim(trim(Instring)))
end; (*Condense*)

(*****
*The upper case procedure uppercases a line of *
*input. If your machine is ASCII then this is *
*fine, if EBCDIC then you must change the *
*conversion factor to 64 and add *
*****)
function Uppercase(InputStr : WordType): WordType;
var
    i          : WordIndexType;
begin
    for i := 1 to length(InputStr) do
        if (InputStr[i] in LowerCaseSet)
            then InputStr[i] := chr(ord(InputStr[i])-32);
    Uppercase := InputStr
end; (* Uppercase *)

(*****
*procedure CheckChars checks for the validity of the *
*input by identifying garbage characters *
*****)

```

(Continued on next page)

GGM — FORTH™ has HELP* for Z80¹ using CP/M²

GGM—FORTH, a complete software system for real-time measurement and control, runs on any Z80 computer under CP/M using an extended fig-FORTH vocabulary.

GGM—FORTH features:

- Open multiple CP/M files, in any combination of direct-access and sequential-access, fully compatible with all CP/M utilities
- Char. in/out uses CP/M console, lister, file, or port
- On-line HELP* provides instant access to definitions in the run-time GGM—FORTH dictionary
- HELP* file is easily extended to include user definitions using HELP* utility
- HELP* is available during full-screen editing

Complete system and manuals	\$150.
Manuals only:	\$ 20.
Introductory System:	\$ 35.

GGM SYSTEMS, INC. (617) 662-0550
135 Summer Ave., Reading, MA 01867

¹ Z80 is a trademark of Zilog, Inc.

² CP/M is a trademark of Digital Research, Inc.

Circle no. 27 on reader service card.

GREP in C

The UNIX* regular
expression recognizer

__MAIN

Wildcard expansion &
pipes for Aztec C

All programs come with complete source
code, in C. Price: \$35 each; \$50 together.

For more information
or complete catalogue:

SOFTWARE ENGINEERING CONSULTANTS

P. O. BOX 5679

BERKELEY, CA 94705

(415) 548-6268

* A trademark of Bell Laboratories

Circle no. 68 on reader service card.

Accent Finder Listing (Listing Continued, text begins on page 82)

```
procedure CheckChars(var Error:boolean; word:wordType);
var
  i:WordIndexType;
begin
  error:=false;
  for i:=1 to length(word) do
    if not (word[i] in Letters)
      then error:=true
  end; (*CheckChars*)
```

```
(*****
*procedure MImsg offers a message if the word is MI *
*Special treatment for two letter words is necessary *
*due to the number of peculiarities. *
*****)
```

```
procedure MImsg;
begin
  writeln('Mi does not take an accent if it is used as a',
    ' possessive pronoun,');
  writeln('but it takes an accent when used as a reflexive',
    ' pronoun .');
  writeln('Example:Mi perro es feo');
  writeln('Me afeitado a mi' mismo.')
```

```
end;
```

```
(*****
*procedure SImsg offers a message if the word is SI *
*****)
```

```
procedure SImsg;
begin
  writeln('The word SI has an accent when used as 'yes',');
  writeln('or when used as a reflexive pronoun.');
```

```
writeln('Example:! Si', me duelen los dientes!');
writeln('Se afeitado a si' mismo.')
```

```
end;
```

```
(*****
*procedure ELmsg offers a message if the word is EL *
*****)
```

```
procedure ELmsg;
begin
  writeln('El has an accent when used as a pronoun and not');
  writeln('when used as an article.');
```

```
writeln('E'l me dio un puno');
writeln('!Deme el dinero!')
```

```
end;
```

```
(*****
The prompt procedure will prompt user for a word, scan it
for invalid input and set an error parameter to true if
so. Else, the word is passed to the PROCESS procedure.
*****)
```

(Continued on page 88)

C BUILDING BLOCKS

Save a year of development.

- ☐ **IBM PC* Building Blocks** \$149
Video & IO routines, string functions, asynchronous port control, date, time, random numbers, printer control. Over 200 functions.
- ☐ **Mathematics Library** \$99
Logarithms, trigonometric functions, square root, random numbers.
- ☐ **Communications Library** \$149
For Hayes Smartmodem†, modem 7 and xmodem.
- ☐ **B-trees & Virtual Memory Management Library** ... \$149
List handling features.
- ☐ **Advanced Building Blocks** \$ 99
Julian dates, dBaseII access, data compression, text windows.

All Building Blocks use the 'IBM PC Building Blocks'.
Credit Cards Accepted. Single User License.
Multiuser licenses available. (Mass. add 5%)

具 NOVUM
ORGANUM

29 Egerton Road, Arlington, MA 02174 Tel: (617) 641-1650
(TM) IBM* (TM) Hayes Microcomputer Products† (TM) Ashton-Tate*

Circle no. 45 on reader service card.

MU FORTH
FOR YOUR IBM PC® ...

Now the advantages of Forth are available for your IBM PC®. Easy to use for both experienced programmers and beginners too, Forth offers the advantages of speed, flexibility, and ease of use.

The MU Forth Package Provides:

- Source and object code user documentation
- Commented source listings in IBM and macro assembler format
- Turtle graphics, sound, and music support
- Keyboard and video support sample programs

Requires:

Your IBM PC, 16K memory, 1 disk drive, PC DOS 1.X, color or monochrome, 40 or 80 column display.

The Price **\$75**

Available from: Art Arizpe
MU Software
115 Cannongate III, Nashua, NH 03063
603-880-9416

SEND CHECK OR MONEY ORDER

Circle no. 42 on reader service card.

Six Times Faster!

Super Fast Z80 Assembly Language Development Package

Z80ASM

- Complete Zilog Mnemonic set
- Full Macro facility
- Plain English error messages
- One or two pass operation
- Over 6000 lines/minute
- Supports nested INCLUDE files
- Allows external bytes, words, and expressions (EXT1 * EXT2)
- Labels significant to 16 characters even on externals (SLR Format Only)
- Integral cross-reference
- Upper/lower case optionally significant
- Conditional assembly
- Assemble code for execution at another address (PHASE & DEPHASE)
- Generates COM, HEX, or REL files
- COM files may start at other than 100H
- REL files may be in Microsoft format or SLR format
- Separate PROG, DATA & COMMON address spaces
- Accepts symbol definitions from the console
- Flexible listing facility includes TIME and DATE in listing (CP/M Plus Only)

SLRINK

- Links any combination of SLR format and Microsoft format REL files
- One or two pass operation allows output files up to 64K
- Generates HEX or COM files
- User may specify PROG, DATA, and COMMON loading addresses
- COM may start at other than 100H
- HEX files do not fill empty address space.
- Generate inter-module cross-reference and load map
- Save symbol table to disk in REL format for use in overlay generation
- Declare entry points from console
- The FASTEST Microsoft Compatible Linker available

SPEED!
FASTER!
SPEED!

- Complete Package Includes: Z80ASM, SLRINK, SLRIB - Librarian and Manual for just \$199.99. Manual only, \$30.
- Most formats available for Z80 CP/M, CDOS, & TURBODOS
- Terms: add \$3 shipping US, others \$7. PA add 6% sales tax

For more information or to order, call:

1-800-833-3061

In PA, (412) 282-0864

Or write: SLR SYSTEMS

1622 North Main Street, Butler, Pennsylvania 16001

SLR Systems

Circle no. 70 on reader service card.

Accent Finder Listing (Listing Continued, text begins on page 82)

```
procedure prompt(var word:WordType; var Error:boolean);
begin
  write('Enter the word > ');
  readln(word);
  word:=UpperCase(Condense(word))
end; (*prompt*)

(*****
*The master procedure of the program that processes the *
*word by dividing it in syllables and computing whether *
*the word has or does not have an accent *
*****)
procedure process(word:wordType);
type
  LetPostType    = 1 .. MaxChar;
  SylPostType    = 1.. MaxSyl;
  SylArray       = array[1..MaxSyl] of string[SylSize];
  SoundType      = array[1..MaxChar] of boolean;
var
  TempString: WordType;
  Syllables:SylArray;
  Vowel,
  Strong,
  Boundary      : SoundType;
  EndPlus,
  CountPlus     : boolean;
  LastSyl,
  StressSyl     : SylPostType;
  StressLet     : LetPostType;

(*****
*The CheckNumeric procedure verifies validity*
*of numeric input in order to proevent a *
*program crash on bad input *
*****)
procedure CheckNumeric(var TempString:WordType);
begin
  while not Numeric(TempString) do
    begin
      writeln('**** Garbage Input ***');
      write('Please enter a numeric value > ');
      readln(TempString)
    end
  end; (*CheckNumeric*)

(*****
*procedure CheckSyl verifies the validity *
*of the syllable number that is supposed *
*to carry the stress. *
*Ie. It should not be 0 and not greater *
*then the number of svllables *
*****)
procedure CheckSyl( var StressSyl:integer);
begin
```



```

while not (StressSyl in [1..LastSyl]) do
  begin
    writeln('Invalid syllable number');
    write('Enter correct emphasis syllable >');
    readln(TempString);
    CheckNumeric(TempString);
    StressSyl:=Convert(TempString)
  end
end; (*CheckSyl*)

```

```

(*****
*The Initialize procedure sets the variables to initial*
*values in preparation for a new word of input          *
*****)
procedure Initialize(var String, Boundary, vowel: SoundType;
                    var Syllable: SylArray);
var
  i: integer;
begin
  for i:=1 to MaxChar do
    begin
      boundary[i]:=false;
      vowel[i]:=false;
      String[i]:=false
    end;
  boundary[length(word)+1]:=true;

```

(Continued on next page)

uniforth

Come to us for your state-of-the-art FORTH needs! Announcing the latest additions to the UNIFORTH family:

16-bit Z8000, 68000, 16032
32-bit 80186, 68000, 16032

Obtain these stock items captured under traditional operating systems, or try our DB16000, Slicer and CompuPro stand-alone versions. Complete compatibility is retained throughout the UNIFORTH product line (from the Commodore 64 to the VAX).

Features include software floating point, video editor, full macro assembler, debugger, decompiler, top-notch documentation, etcetera. Prices start at \$175. Call or write for our free brochure.

Unified Software Systems

P.O. Box 2644, New Carrollton, MD 20784. 301/552-9590

DEC, VAX, PDP, RT-11, RSX-11 (TM) Digital Equipment Corp; CP/M (TM) Digital Research; MSDOS (TM) Microsoft; VIC-20 (TM) Commodore.

Circle no. 76 on reader service card.

'C' COMPILER

AN OUTSTANDING VALUE

"We bought and evaluated over \$1500.00 worth of 'C' compilers... C/80 is the one we use."

Dr. Bruce E. Wampler, Aspen Software
author of "Grammatik"

C/80 Full featured C Compiler for CP/M[®] with I/O redirection, command expansion, execution trace and profile, initializers, Macro-80 compatibility, ROMable code.

49⁹⁵

C/80 FLOATS & LONGS Adds 32 bit data types to C/80 3.0 compiler. Includes I/O and transcendental function library.

29⁹⁵

FREE CATALOG Call or write for 16 page booklet detailing our programming languages LISP/80, RATFOR, Assemblers, and 25 other CP/M products.



15233 Ventura Blvd., #1118
Sherman Oaks, CA 91403

(213) 986-4885
Dealer inquiries invited.

CP/M is a registered trademark of Digital Research, Inc.

Circle no. 69 on reader service card.

Accent Finder Listing (Listing Continued, text begins on page 82)

```
    for i:=1 to MaxSyl do Syllable[i]:=''
end; (*Initialize*)

(*****
*procedure SetQuality sets the quality of each *
*sound of the word. Ie. if a vowel then the vowel*
*flag is turned on and if a strong vowel then the*
*strong flag is turned. *
*****)
procedure SetQuality(var Strong,vowel:SoundType);
var
    i:integer;
begin
    for i:=1 to length(word) do
        if word[i] in vowels
        then
            begin
                vowel[i]:=true;
                if word[i] in StrongVowels
                then Strong[i]:=true
            end
        end;
    end;
end; (*SetQuality*)

(*****
*the SetSylls procedure sets the boundary between the *
*syllables of the word according to strength and value.*
*****)
procedure SetSylls(var Boundary:SoundType; word:wordType;
    vowel :SoundType);
var
    i:integer;
begin
    for i:=2 to length(word) do
        begin
            if ((not vowel[i]) and vowel[i-1])
            or ((word[i-1] = 'N') and (word[i]='T'))
            or (strong[i-1] and (not strong[i]))
            or (strong[i-1] and strong[i])
            or (strong[i] and (not strong[i-1]) and vowel[i-1])
            then boundary[i]:=true;
            if i>2 then
                if (vowel[i-2] and (not vowel[i-1]) and (not vowel[i])
                    and (word[i]=word[i-1]))
                then
                    begin
                        boundary[i-1]:=true;
                        boundary[i]:=false
                    end
                end
            end;
        end;
    end;
end; (*SetSylls*)

(*****
*The SplitConsonants splits two neighbouring consonants in *
*syllables (except ll) *
*****)
```



```

procedure SplitConsonants(var boundary:SoundType; word:WordType;
                           vowel :SoundType);

```

```

var
  i:integer;
begin
  for i:=3 to length(word) do
    if vowel[i-2] and (not vowel[i-1]) and (not vowel[i])
    then
      begin
        boundary[i-1]:=false;
        boundary[i]:=true
      end
    end; (*SplitConsonants*)

```

```

(*****
*The WeldCH procedure insures that C and H go in *
*the same syllable *
*****)

```

```

procedure WeldCH(var boundary: SoundType; word:wordType;
                  vowel :SoundType);

```

```

var
  i:integer;
begin
  for i:=3 to length(word) do
    begin
      if (word[i-1]='C') and (not Boundary[i-1]) and

```

(Continued on next page)

A Professional Quality Z80/8080 Disassembler

REVAS Version 3

Uses either ZILOG or 8080 mnemonics
Includes UNDOCUMENTED Z80 opcodes
Handles both BYTE (DB) & WORD (DW) data
Disassembles object code up to 64k long!
Lets you insert COMMENTS in the disassembly!

A powerful command set gives you:

INTERACTIVE disassembly
Command Strings & Macros
On-line Help
Calculations in ANY Number Base!
Flexible file and I/O control
All the functions of REVAS V2.5

REVAS:

Is fully supported with low cost user updates
Runs in a Z80 CPU under CP/M*
Is normally supplied on SSSD 8" diskette
Revas V 3...\$90.00 Manual only...\$15.00
California Residents add 6½% sales tax

REVASCO

6032 Charlton Ave., Los Angeles, CA. 90056
(213) 649-3575

*CP/M is a Trademark of Digital Resaerch, Inc.

Circle no. 61 on reader service card.

C Programmers: Program three times faster with Instant-C™

Instant-C™ makes programming three or more times faster by eliminating the time wasted by traditional compilers. Many repetitive programming tasks are automated to make programming less frustrating and tedious.

- Two seconds elapsed time from completion of editing to execution.
 - Full-screen editor integrated with compiler; compile errors set cursor to trouble spot.
 - Editor available any time during session.
 - Symbolic debugging; single step by statement.
 - Automatic recompilation when needed. Never a mismatch between source and object code.
 - Directly generates .COM, .EXE, or .CMD files.
 - Follows K & R—works with existing source.
 - Single, integrated package.
 - Works under PC-DOS*, MS-DOS*, CP/M-86*.
- More productivity, less frustration, better programs.
Instant-C™ is \$500. Call or write for more information.

Rational
Systems, Inc.

(617) 653-6194
P.O. Box 480
Natick, Mass. 01760

*[Trademarks: PC-DOS (IBM), MS-DOS (Microsoft), CP/M-86 (Digital Research, Inc.)
Instant-C (Rational/Systems, Inc.)]

Circle no. 59 on reader service card.

Accent Finder Listing (Listing Continued, text begins on page 82)

```
        (word[i] = 'H') and boundary[i]
      then
        begin
          Boundary[i-1] := true;
          Boundary[i] := false
        end
      end
    end; (*WeldCH*)

(*****
*Liquids (l and r) must be spliced to the next      *
*syllable                                           *
*****)
procedure WeldLiquids(var boundary: Soundtype; word: wordType;
                      vowel   : SoundType);
var
  i: integer;
begin
  for i := 3 to length(word) do
    if vowel[i-2] and
       (not vowel[i-1]) and (not vowel[i]) and
       (word[i] in liquids)
    then
      begin
        boundary[i-1] := true;
        boundary[i] := false
      end
    end; (*WeldLiquids*)

(*****
*The divide procedure sets the array of strings 'Syllables'*
*to the values of the word syllables by splicing together *
*the letters of a word up to a letter marked as a syllable *
*****)
procedure divide(boundary: SoundType; var Syllables: SylArray);
var
  i,
  j: integer;
begin
  i := 1;
  Syllables[i] := copy(word, 1, 1);
  i := 2;
  while i <= length(word) do
    begin
      if not boundary[i]
      then Syllables[i] := Syllables[i] + copy(word, i, 1)
      else
        begin
          Syllables[i+1] := copy(word, i, 1);
          i := i+1
        end;
      i := i+1
    end
  end;
end; (*divide*)
```



```

(*****
*The EvalSylls procedure displays the word split in syllables*
*and it also returns their total number.*
*The syllables are numbered.*
*****)

```

```

procedure EvalSylls(syllables: SylArray; var LastSyl:integer);
var
  i:integer;
begin
  i:=1;
  while syllables[i]<>' ' do
    begin
      write('***',i:1,'->',syllables[i]);
      i:=i+1
    end;
  LastSyl:=i-1
end; (*EvalSyll*)

```

```

(*****
*The procedure SetStressLet will set the position *
* of the stress letter by doing some calculations *
* I.e. looking for the stressed vowel within the *
* stressed syllable *
*****)
procedure SetStressLet(var StressLet:integer);

```

(Continued on next page)

GET THE ONLY 1200 BAUD BELL 212A

S-100 MODEM

BY

U. S. ROBOTICS

from the experts in Data Comm that have made it really work! We offer the S-100 from stock at the best price around, plus the only software specially designed for it.

S-100 Modem: 150/300/600/1200 baud auto dial/answer Hayes compatible; audio monitor, direct connect, on an S-100 card.....\$339

Password: stand-alone Bell 212A modem in plastic case with RS-232C cable, same features as S-100.....\$339

Lamp software: Modem 7 xfer, fully buffered to disk and printer, dialing directory, host of features for most CP/M 80 machines.....\$20

Cash price with U.S. shipping; Visa/MC/Net30
add 3%, COD \$6.

Widener Consulting
2835 NE Brogden
Hillsboro, OR 97124
(503) 648-0363



Circle no. 80 on reader service card.

NEW
IBM-PC
DEBUGGER

"...by far the best debugging tool
available for the IBM-PC today."
S. Lerner, Multi Systems Group

CodeSmith™-86

CPU: 286, 386, 486, 586, 686, 786, 886, 986, 1086, 1186, 1286, 1386, 1486, 1586, 1686, 1786, 1886, 1986, 2086, 2186, 2286, 2386, 2486, 2586, 2686, 2786, 2886, 2986, 3086, 3186, 3286, 3386, 3486, 3586, 3686, 3786, 3886, 3986, 4086, 4186, 4286, 4386, 4486, 4586, 4686, 4786, 4886, 4986, 5086, 5186, 5286, 5386, 5486, 5586, 5686, 5786, 5886, 5986, 6086, 6186, 6286, 6386, 6486, 6586, 6686, 6786, 6886, 6986, 7086, 7186, 7286, 7386, 7486, 7586, 7686, 7786, 7886, 7986, 8086, 8186, 8286, 8386, 8486, 8586, 8686, 8786, 8886, 8986, 9086, 9186, 9286, 9386, 9486, 9586, 9686, 9786, 9886, 9986, 10086, 10186, 10286, 10386, 10486, 10586, 10686, 10786, 10886, 10986, 11086, 11186, 11286, 11386, 11486, 11586, 11686, 11786, 11886, 11986, 12086, 12186, 12286, 12386, 12486, 12586, 12686, 12786, 12886, 12986, 13086, 13186, 13286, 13386, 13486, 13586, 13686, 13786, 13886, 13986, 14086, 14186, 14286, 14386, 14486, 14586, 14686, 14786, 14886, 14986, 15086, 15186, 15286, 15386, 15486, 15586, 15686, 15786, 15886, 15986, 16086, 16186, 16286, 16386, 16486, 16586, 16686, 16786, 16886, 16986, 17086, 17186, 17286, 17386, 17486, 17586, 17686, 17786, 17886, 17986, 18086, 18186, 18286, 18386, 18486, 18586, 18686, 18786, 18886, 18986, 19086, 19186, 19286, 19386, 19486, 19586, 19686, 19786, 19886, 19986, 20086, 20186, 20286, 20386, 20486, 20586, 20686, 20786, 20886, 20986, 21086, 21186, 21286, 21386, 21486, 21586, 21686, 21786, 21886, 21986, 22086, 22186, 22286, 22386, 22486, 22586, 22686, 22786, 22886, 22986, 23086, 23186, 23286, 23386, 23486, 23586, 23686, 23786, 23886, 23986, 24086, 24186, 24286, 24386, 24486, 24586, 24686, 24786, 24886, 24986, 25086, 25186, 25286, 25386, 25486, 25586, 25686, 25786, 25886, 25986, 26086, 26186, 26286, 26386, 26486, 26586, 26686, 26786, 26886, 26986, 27086, 27186, 27286, 27386, 27486, 27586, 27686, 27786, 27886, 27986, 28086, 28186, 28286, 28386, 28486, 28586, 28686, 28786, 28886, 28986, 29086, 29186, 29286, 29386, 29486, 29586, 29686, 29786, 29886, 29986, 30086, 30186, 30286, 30386, 30486, 30586, 30686, 30786, 30886, 30986, 31086, 31186, 31286, 31386, 31486, 31586, 31686, 31786, 31886, 31986, 32086, 32186, 32286, 32386, 32486, 32586, 32686, 32786, 32886, 32986, 33086, 33186, 33286, 33386, 33486, 33586, 33686, 33786, 33886, 33986, 34086, 34186, 34286, 34386, 34486, 34586, 34686, 34786, 34886, 34986, 35086, 35186, 35286, 35386, 35486, 35586, 35686, 35786, 35886, 35986, 36086, 36186, 36286, 36386, 36486, 36586, 36686, 36786, 36886, 36986, 37086, 37186, 37286, 37386, 37486, 37586, 37686, 37786, 37886, 37986, 38086, 38186, 38286, 38386, 38486, 38586, 38686, 38786, 38886, 38986, 39086, 39186, 39286, 39386, 39486, 39586, 39686, 39786, 39886, 39986, 40086, 40186, 40286, 40386, 40486, 40586, 40686, 40786, 40886, 40986, 41086, 41186, 41286, 41386, 41486, 41586, 41686, 41786, 41886, 41986, 42086, 42186, 42286, 42386, 42486, 42586, 42686, 42786, 42886, 42986, 43086, 43186, 43286, 43386, 43486, 43586, 43686, 43786, 43886, 43986, 44086, 44186, 44286, 44386, 44486, 44586, 44686, 44786, 44886, 44986, 45086, 45186, 45286, 45386, 45486, 45586, 45686, 45786, 45886, 45986, 46086, 46186, 46286, 46386, 46486, 46586, 46686, 46786, 46886, 46986, 47086, 47186, 47286, 47386, 47486, 47586, 47686, 47786, 47886, 47986, 48086, 48186, 48286, 48386, 48486, 48586, 48686, 48786, 48886, 48986, 49086, 49186, 49286, 49386, 49486, 49586, 49686, 49786, 49886, 49986, 50086, 50186, 50286, 50386, 50486, 50586, 50686, 50786, 50886, 50986, 51086, 51186, 51286, 51386, 51486, 51586, 51686, 51786, 51886, 51986, 52086, 52186, 52286, 52386, 52486, 52586, 52686, 52786, 52886, 52986, 53086, 53186, 53286, 53386, 53486, 53586, 53686, 53786, 53886, 53986, 54086, 54186, 54286, 54386, 54486, 54586, 54686, 54786, 54886, 54986, 55086, 55186, 55286, 55386, 55486, 55586, 55686, 55786, 55886, 55986, 56086, 56186, 56286, 56386, 56486, 56586, 56686, 56786, 56886, 56986, 57086, 57186, 57286, 57386, 57486, 57586, 57686, 57786, 57886, 57986, 58086, 58186, 58286, 58386, 58486, 58586, 58686, 58786, 58886, 58986, 59086, 59186, 59286, 59386, 59486, 59586, 59686, 59786, 59886, 59986, 60086, 60186, 60286, 60386, 60486, 60586, 60686, 60786, 60886, 60986, 61086, 61186, 61286, 61386, 61486, 61586, 61686, 61786, 61886, 61986, 62086, 62186, 62286, 62386, 62486, 62586, 62686, 62786, 62886, 62986, 63086, 63186, 63286, 63386, 63486, 63586, 63686, 63786, 63886, 63986, 64086, 64186, 64286, 64386, 64486, 64586, 64686, 64786, 64886, 64986, 65086, 65186, 65286, 65386, 65486, 65586, 65686, 65786, 65886, 65986, 66086, 66186, 66286, 66386, 66486, 66586, 66686, 66786, 66886, 66986, 67086, 67186, 67286, 67386, 67486, 67586, 67686, 67786, 67886, 67986, 68086, 68186, 68286, 68386, 68486, 68586, 68686, 68786, 68886, 68986, 69086, 69186, 69286, 69386, 69486, 69586, 69686, 69786, 69886, 69986, 70086, 70186, 70286, 70386, 70486, 70586, 70686, 70786, 70886, 70986, 71086, 71186, 71286, 71386, 71486, 71586, 71686, 71786, 71886, 71986, 72086, 72186, 72286, 72386, 72486, 72586, 72686, 72786, 72886, 72986, 73086, 73186, 73286, 73386, 73486, 73586, 73686, 73786, 73886, 73986, 74086, 74186, 74286, 74386, 74486, 74586, 74686, 74786, 74886, 74986, 75086, 75186, 75286, 75386, 75486, 75586, 75686, 75786, 75886, 75986, 76086, 76186, 76286, 76386, 76486, 76586, 76686, 76786, 76886, 76986, 77086, 77186, 77286, 77386, 77486, 77586, 77686, 77786, 77886, 77986, 78086, 78186, 78286, 78386, 78486, 78586, 78686, 78786, 78886, 78986, 79086, 79186, 79286, 79386, 79486, 79586, 79686, 79786, 79886, 79986, 80086, 80186, 80286, 80386, 80486, 80586, 80686, 80786, 80886, 80986, 81086, 81186, 81286, 81386, 81486, 81586, 81686, 81786, 81886, 81986, 82086, 82186, 82286, 82386, 82486, 82586, 82686, 82786, 82886, 82986, 83086, 83186, 83286, 83386, 83486, 83586, 83686, 83786, 83886, 83986, 84086, 84186, 84286, 84386, 84486, 84586, 84686, 84786, 84886, 84986, 85086, 85186, 85286, 85386, 85486, 85586, 85686, 85786, 85886, 85986, 86086, 86186, 86286, 86386, 86486, 86586, 86686, 86786, 86886, 86986, 87086, 87186, 87286, 87386, 87486, 87586, 87686, 87786, 87886, 87986, 88086, 88186, 88286, 88386, 88486, 88586, 88686, 88786, 88886, 88986, 89086, 89186, 89286, 89386, 89486, 89586, 89686, 89786, 89886, 89986, 90086, 90186, 90286, 90386, 90486, 90586, 90686, 90786, 90886, 90986, 91086, 91186, 91286, 91386, 91486, 91586, 91686, 91786, 91886, 91986, 92086, 92186, 92286, 92386, 92486, 92586, 92686, 92786, 92886, 92986, 93086, 93186, 93286, 93386, 93486, 93586, 93686, 93786, 93886, 93986, 94086, 94186, 94286, 94386, 94486, 94586, 94686, 94786, 94886, 94986, 95086, 95186, 95286, 95386, 95486, 95586, 95686, 95786, 95886, 95986, 96086, 96186, 96286, 96386, 96486, 96586, 96686, 96786, 96886, 96986, 97086, 97186, 97286, 97386, 97486, 97586, 97686, 97786, 97886, 97986, 98086, 98186, 98286, 98386, 98486, 98586, 98686, 98786, 98886, 98986, 99086, 99186, 99286, 99386, 99486, 99586, 99686, 99786, 99886, 99986, 100086, 100186, 100286, 100386, 100486, 100586, 100686, 100786, 100886, 100986, 101086, 101186, 101286, 101386, 101486, 101586, 101686, 101786, 101886, 101986, 102086, 102186, 102286, 102386, 102486, 102586, 102686, 102786, 102886, 102986, 103086, 103186, 103286, 103386, 103486, 103586, 103686, 103786, 103886, 103986, 104086, 104186, 104286, 104386, 104486, 104586, 104686, 104786, 104886, 104986, 105086, 105186, 105286, 105386, 105486, 105586, 105686, 105786, 105886, 105986, 106086, 106186, 106286, 106386, 106486, 106586, 106686, 106786, 106886, 106986, 107086, 107186, 107286, 107386, 107486, 107586, 107686, 107786, 107886, 107986, 108086, 108186, 108286, 108386, 108486, 108586, 108686, 108786, 108886, 108986, 109086, 109186, 109286, 109386, 109486, 109586, 109686, 109786, 109886, 109986, 110086, 110186, 110286, 110386, 110486, 110586, 110686, 110786, 110886, 110986, 111086, 111186, 111286, 111386, 111486, 111586, 111686, 111786, 111886, 111986, 112086, 112186, 112286, 112386, 112486, 112586, 112686, 112786, 112886, 112986, 113086, 113186, 113286, 113386, 113486, 113586, 113686, 113786, 113886, 113986, 114086, 114186, 114286, 114386, 114486, 114586, 114686, 114786, 114886, 114986, 115086, 115186, 115286, 115386, 115486, 115586, 115686, 115786, 115886, 115986, 116086, 116186, 116286, 116386, 116486, 116586, 116686, 116786, 116886, 116986, 117086, 117186, 117286, 117386, 117486, 117586, 117686, 117786, 117886, 117986, 118086, 118186, 118286, 118386, 118486, 118586, 118686, 118786, 118886, 118986, 119086, 119186, 119286, 119386, 119486, 119586, 119686, 119786, 119886, 119986, 120086, 120186, 120286, 120386, 120486, 120586, 120686, 120786, 120886, 120986, 121086, 121186, 121286, 121386, 121486, 121586, 121686, 121786, 121886, 121986, 122086, 122186, 122286, 122386, 122486, 122586, 122686, 122786, 122886, 122986, 123086, 123186, 123286, 123386, 123486, 123586, 123686, 123786, 123886, 123986, 124086, 124186, 124286, 124386, 124486, 124586, 124686, 124786, 124886, 124986, 125086, 125186, 125286, 125386, 125486, 125586, 125686, 125786, 125886, 125986, 126086, 126186, 126286, 126386, 126486, 126586, 126686, 126786, 126886, 126986, 127086, 127186, 127286, 127386, 127486, 127586, 127686, 127786, 127886, 127986, 128086, 128186, 128286, 128386, 128486, 128586, 128686, 128786, 128886, 128986, 129086, 129186, 129286, 129386, 129486, 129586, 129686, 129786, 129886, 129986, 130086, 130186, 130286, 130386, 130486, 130586, 130686, 130786, 130886, 130986, 131086, 131186, 131286, 131386, 131486, 131586, 131686, 131786, 131886, 131986, 132086, 132186, 132286, 132386, 132486, 132586, 132686, 132786, 132886, 132986, 133086, 133186, 133286, 133386, 133486, 133586, 133686, 133786, 133886, 133986, 134086, 134186, 134286, 134386, 134486, 134586, 134686, 134786, 134886, 134986, 135086, 135186, 135286, 135386, 135486, 135586, 135686, 135786, 135886, 135986, 136086, 136186, 136286, 136386, 136486, 136586, 136686, 136786, 136886, 136986, 137086, 137186, 137286, 137386, 137486, 137586, 137686, 137786, 137886, 137986, 138086, 138186, 138286, 138386, 138486, 138586, 138686, 138786, 138886, 138986, 139086, 139186, 139286, 139386, 139486, 139586, 139686, 139786, 139886, 139986, 140086, 140186, 140286, 140386, 140486, 140586, 140686, 140786, 140886, 140986, 141086, 141186, 141286, 141386, 141486, 141586, 141686, 141786, 141886, 141986, 142086, 142186, 142286, 142386, 142486, 142586, 142686, 142786, 142886, 142986, 143086, 143186, 143286, 143386, 143486, 143586, 143686, 143786, 143886, 143986, 144086, 144186, 144286, 144386, 144486, 144586, 144686, 144786, 144886, 144986, 145086, 145186, 145286, 145386, 145486, 145586, 145686, 145786, 145886, 145986, 146086, 146186, 146286, 146386, 146486, 146586, 146686, 146786, 146886, 146986, 147086, 147186, 147286, 147386, 147486, 147586, 147686, 147786, 147886, 147986, 148086, 148186, 148286, 148386, 148486, 148586, 148686, 148786, 148886, 148986, 149086, 149186, 149286, 149386, 149486, 149586, 149686, 149786, 149886, 149986, 150086, 150186, 150286, 150386, 150486, 150586, 150686, 150786, 150886, 150986, 151086, 151186, 151286, 151386, 151486, 151586, 151686, 151786, 151886, 151986, 152086, 152186, 152286, 152386, 152486, 152586, 152686, 152786, 152886,									
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	--	--	--	--	--	--	--	--

Accent Finder Listing (Listing Continued, text begins on page 82)

```
var
    SyllCount,
    i           :integer;
begin
    SyllCount:=1;
    for i:=1 to length(word) do
        begin
            if Boundary[i]
            then SyllCount:=SyllCount+1;
            if (SyllCount=StressSyl) and Vowel[i]
            then StressLet:=i
        end
    end; (*SetStressLet*)

    (*****
    *procedure DisplayAccent displays the word      *
    *with its written accent as a slash next to    *
    *the letter supposed to carry it.              *
    *****)
    procedure DisplayAccent(word:WordType);
    var
        i:integer;
    begin
        writeln('The word ',word,' has a written accent ');
        for i:=1 to length(word) do
            begin
                write(' ',word[i]);
                if i=StressLet then write('/')
                else write(' ')
            end;
        writeln
    end; (*DisplayAccent*)

    (*****
    procedure InfoMsg comes to work after all      *
    procedures have done their work and it         *
    explains why certain decisions were made        *
    *****)
    procedure InfoMsg(word: WordType; EndPlus, CountPlus: boolean);
    begin
        writeln('The final letter is ',word[length(word)]);
        write('Thus a ');
        if EndPlus then write('+')
        else write('-');
        writeln(' must be assigned for the word ending. ');
        writeln('The emphasis is on syllable #',StressSyl);
        write('Thus we must assign ');
        if CountPlus then write('+')
        else write('-');
        writeln(' for the emphasis placement. ');
        writeln('Reasons considered for the above decision: ');
        If EndPlus<>CountPlus
        then writeln('The signs are different so there is an accent!')
        else writeln('The signs are the same so there is no accent!');
        if (not strong[length(word)-1]) and vowel[length(word)-1] and
```



```

    Strong[Length(word)]
    then writeln('The word ends with a diphthong, there is an accent.')
    if strong[StressLet-1] and (not strong[StressLet])
    then writeln('A split diphthong, there is an accent.');
```

if (word[length(word)-1]='P') and (word[length(word)]='S')

```

    then writeln('Words ending in PS always get accents!');
    if (length(word)=3) and (not vowel[1])
    then writeln('Three letter words are affected by semantics',
        ' (Ex. mas vs. ma's)')
end; (*InfoMsg*)

begin(*of the process procedure*)
    Initialize(Strong,Boundary,vowel,Syllables);
    SetQuality(strong,vowel);
    SetSylls(boundary,word,vowel);
    SplitConsonants(boundary,word,vowel);
    WeldCH(boundary,word,vowel);
    WeldLiquids(boundary,word,vowel);
    if not vowel[length(word)]
    then boundary[length(word)]:=false;
    divide(boundary,syllables);
    EvalSylls(syllables,LastSyl);
    write('Enter the number of emphasis syllable > ');
    readln(TempString);
    CheckNumeric(TempString);
    StressSyl:=Convert(TempString);

```

(Continued on next page)



WRITE

The Writer's Really Incredible Text Editor lives up to its name! It's designed for creative and report writing and carefully protects your text. Includes many features missing from WordStar, such as sorted directory listings, fast scrolling, and trial printing to the screen. All editing commands are single-letter and easily changed. Detailed manual included. WRITE is \$239.00.

WORKMAN & ASSOCIATES

112 Marion Avenue
Pasadena, CA 91106
(818) 796-4401

All US orders are postpaid. We ship from stock on many formats, including: 8", Apple, Osborne, KayPro, Otrona, Epson, Morrow, Lobo, Zenith, Xerox. Please request our new catalog. We welcome COD orders.

Circle no. 82 on reader service card.

SMALL C FOR IBM-PC

Small-C Compiler Version
2.1 for PC-DOS/MS-DOS
Source Code included
for Compiler & Library
New 8086 optimizations
Rich I/O & Standard Library

\$
40

CBUG SOURCE LEVEL DEBUGGER FOR SMALL C

Break, Trace, and Change
variables all on the
source level
Source code included

\$
40

Datalight

11557 8th Ave. N.E.
Seattle, Washington 98125

ASM or MASM is required with compiler.
Include disk size (160k/320k), and DOS version with order.
VISA & MasterCard accepted. Include card no. & expiration date.
Washington state residents include 7.9% sales tax.
IBM-PC & PC-DOS are trademarks of International Business Machines
MS-DOS is a trademark of Microsoft Corporation.

Circle no. 22 on reader service card.

Accent Finder Listing (Listing Continued, text begins on page 82)

```
CheckSyl(StressSyl);
SetStressLet(StressLet);
EndPlus:=false;
CountPlus:=false;
if not ((not vowel[length(word)]) and (not vowel[length(word)-1]))
then if (vowel[length(word)]) or
      (word[length(word)] in ['N','S'])
      then EndPlus:=true;
if LastSyl-StressSyl=1 then CountPlus:=true;
if (EndPlus<>CountPlus) or
  ((length(word) > 3) and
   strong[StressLet-1] and (not strong[StressLet])) or
  (((not strong[length(word)-1]) and Vowel[length(word)-1]) and
   Strong[length(word)])
then DisplayAccent(word)
else writeln('No accent !');
InfoMsg(word,EndPlus,CountPlus)
end; (*Process*)

begin (*main*)
word:='xxx';
vowels:=['A','E','I','O','U'];
liquids:=['L','R'];
StrongVowels:=['A','E','O'];
LowerCaseSet:=['a'..'z'];
Letters:=['A'..'Z'];
writeln('Please remeber that all interrogatives get an accent');
writeln('when used in a question. ');
writeln('Ex: ?Que'' dice?');
writeln('      E''l dice que tiene once anos. ');
writeln('To stop enter ''Return'' without input');
while word<>'' do
  begin
    Prompt(word,error);
    if (word<>'') and (not error)
    then
      begin
        if length(word) < 3 then
          case length(word) of
            1: writeln('Monosounds do not have accents');
            2: if word='SI' then SImsg
                else if word='MI' then MImsg
                else if word='EL' then ELmsg
                else
                  writeln('Probably no accent !')
          end
        else Process(word)
        end
      end;
    writeln('!!Que la fuerza este'' contigo!!')
  end.
```

End Listing



BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 756 MENLO PARK, CA

POSTAGE WILL BE PAID BY ADDRESSEE

Dr. Dobb's Journal

For the Experienced in Microcomputing

**2464 EMBARCADERO WAY
PALO ALTO, CA 94303**



BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 756 MENLO PARK, CA

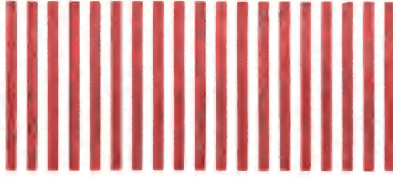
POSTAGE WILL BE PAID BY ADDRESSEE

Dr. Dobb's Journal

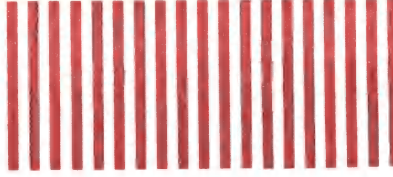
For the Experienced in Microcomputing

**2464 EMBARCADERO WAY
PALO ALTO, CA 94303**

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



Dr. Dobb's Journal

For the Experienced in Microcomputing

Reader Service Card

To obtain information about products or services mentioned in this issue, circle the appropriate number listed below. Use bottom row to vote for best article in issue. This card is valid for 90 days from issue date. Use only one card per person.

May 1984, No. 91

Name _____

Address _____

City/State/Zip _____

Phone () _____

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81
82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108
109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135

Articles: 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214

Comments: _____

Purchase of Magazine:

- ☐ 1 Subscription
☐ 2 Computer Store
☐ 3 Newsstand
☐ 4 Bookstore
☐ 5 Passed on by friend/colleague
☐ 6 Other _____

Dr. Dobb's Journal

For the Experienced in Microcomputing

Reader Service Card

To obtain information about products or services mentioned in this issue, circle the appropriate number listed below. Use bottom row to vote for best article in issue. This card is valid for 90 days from issue date. Use only one card per person.

May 1984, No. 91

Name _____

Address _____

City/State/Zip _____

Phone () _____

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81
82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108
109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135

Articles: 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214

Comments: _____

Purchase of Magazine:

- ☐ 1 Subscription
☐ 2 Computer Store
☐ 3 Newsstand
☐ 4 Bookstore
☐ 5 Passed on by friend/colleague
☐ 6 Other _____



BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 756 MENLO PARK, CA

POSTAGE WILL BE PAID BY ADDRESSEE

Dr. Dobb's Journal

For the Experienced in Microcomputing

2464 EMBARCADERO WAY
PALO ALTO, CA 94303



BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 756 MENLO PARK, CA

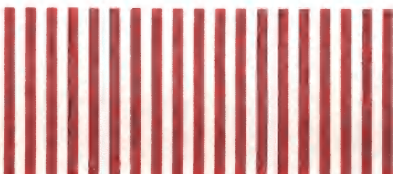
POSTAGE WILL BE PAID BY ADDRESSEE

Dr. Dobb's Journal

For the Experienced in Microcomputing

2464 EMBARCADERO WAY
PALO ALTO, CA 94303

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



Dr. Dobb's Journal
NOW AT BIGGER SAVINGS!

~~\$35.40~~
\$25.00

If you take advantage of this special offer you save over \$10 off newsstand prices, that's a 30% savings!

Please charge my: ☐ Visa ☐ MasterCard ☐ American Express
☐ Payment enclosed ☐ Bill me later

Card # _____ Exp. date _____

Signature _____

Name _____

Address _____

City _____ State _____ Zip _____ V4

Offer good in USA only. Foreign rates upon request. Please allow up to six weeks for first issue.
This offer good until August 31, 1984.

A publication of People's Computer Co., P.O. Box E, Menlo Park, CA 94026.

Dear Reader,

May 1984, No. 91

Dr. Dobb's has a long tradition of listening to its readers. We like to hear when something really helps or, for that matter, bothers you. In this hectic world of ours, however, it is often difficult to take the time to write a letter. This card provides you with a quick and easy way to correspond. Simply fill it out and drop it in the mail. We take care of the rest. Thanks for taking a few minutes to talk with us.

-Ed.

Which articles or departments did you enjoy the most this month? Why?
(Please indicate order of preference.)

Comments or suggestions: _____

Name _____

Address _____

DDJ BACK ISSUES

- #66 Volume VII, No. 4: 8080-Z80/8086 Cross-Assembler, Part 2 - Writing the Runic Compiler - Poor Person's Spelling Checker.
- #68 Volume VII, No. 6: Multi-68000 Personal Computer - PDP-1802, Part One - Improved LET for LLL Basic - CP/M Print Utility.
- #69 Volume VII, No. 7: IBM-PC Issue! CP/M-86 vs. MSDOS (A Technical Comparison) - Hi-Res Graphics on the IBM-PC - PDP-1802, Part II - Review of Word Processors for IBM.
- #70 Volume VII, No. 8: Argum "C" Command Line Processor - SEND/RECEIVE File Transfer Utilities - Intel's 8087 - Performance Evaluation.
- #71 Volume VII, No. 9: FORTH Issue! Floating-Point Package - H-19 Screen Editor - Relocating, Linking Loader - Z8000 Forth - Forth Programming Style - 8086 ASCII-Binary Conversion Routines - CP/M Conditional SUBMIT.
- #72 Volume VII, No. 10: Portable Pidgin for Z80 - 68000 Cross Assembler, Part I - MODEM and RCP/Ms - Simplified 68000 Mnemonics - Nested Submits - 8086/88 Trig Lookup.
- #73 Volume VII, No. 11: Wildcard UNIX Filenames - Tests for Pidgin - 68000 Cross Assembler Listing, Part 2 - Adding More BDOS Calls - The Perfect Hash - BASIC Memory Management - Benchmarks for CP/M-86 vs. MSDOS, and the 8087.
- #75 Volume VIII, No. 1: Augusta, An ADA Subset for Micros - Xanadu: Hypertext from the Future - Stone Age Computers: 6000 Years of Computing Science - Small-C Compiler v2., Part 2.
- #76 Volume VIII, Issue 2: PISTOL, A Forth-like Portably Implemented Stack Oriented Language - Program Linkage by Coroutines, Forth to BASIC - Linking CP/M Functions to Your High-Level Program - Concurrent CP/M-86 - Small Systems Engineering CP/M-80 Expansion Card for the Victor 9000 - REVAS Disassembler.
- #77 Volume VIII, Issue 3: Augusta, Part II: The Augusta P-Code Interpreter - A Small-C Operating System - 6809 Threaded Code: Parametrization and Transfer of Control - A Common-Sense Guide to Faster, Small BASIC - A Fundamental Mistake in Compiler Design - Basic Disk I/O, Part I.
- #78 Volume VIII, Issue 4: RECLAIM Destroyed Directories - Binary Magic Numbers - 8080 Fig-Forth Directory & File System - SAY" Forth Votrax Driver - TRS-80 8080 to Z80 Translator - Basic Disk I/O, Part II.
- #79 Volume VIII, No. 5: Augusta Part III: The Augusta Compiler - A Fast Circle Routine - Enhancing the C Screen Editor - Shifts and Rotations on the Z80 - The SCB, TSX, and TXS Instructions of the 6502 and 6800 - MS-DOS vs. CP/M-86 - Controlling MBASIC - The Buffered Keyboard - IBM PC Character Set Linker - Flip Utility for the IBM PC.
- #80 Volume VIII, Issue 6: Fast Divisibility Algorithms - B-Tree ISAM Concepts - CP/M BDOS and BIOS Calls for C - Serial Expansion in Forth - Fast Matrix Operations in Forth, Part I - Yes, You Can Trace Through BDOS - Julian Dates for Microcomputers - 8088 Addressing Modes - 8088 Line Generator - CP/M Plus.
- #81 Volume VIII, Issue 7: Augusta, Part IV (The Augusta Compiler, continued) - RED: A Better Screen Editor, Part I - Anatomy of a Digital Vector and Curve Generator - Fast Matrix Operations in Forth, Part II - The AGGHHH! Program - MBOOT Revisited - CP/M Plus Feedback - MS-DOS Rebuttal - 68000 Tools - Sizing Memory on the IBM PC.
- #82 Volume VIII, Issue 8: Serial-to-Parallel: A Flexible Utility Box - McWORDER: A Tiny Text Editor - And Still More Fifth Generation Computers! - Specialist Symbols and I/O Benchmarks for CP/M Plus - CP/M Plus Memory Management - Zero Length File Test - PAUSEIF, QUITIF, and now SKIPIF - ACTxx Cross Assemblers.
- #83 Volume VIII, No. 9: FORTH ISSUE! Forth and the Motorola 68000 - Non-deterministic Control Words in Forth - A 68000 Forth Assembler - GO in Forth - Precompiled Forth Modules - Signed Integer Division - Some Forth Coding Standards - The Forth Sort - A speed and accuracy benchmark program for high-level languages - Using a Digital Spreadsheet Program for Something Fun and Unusual.
- #84 Volume VIII, No. 10: DDJ's new C/Unix column! - Unix to CP/M Floppy Disk File Conversion - A Small-C Help Facility - Attaching a Winchester Hard Disk to the S-100 Bus - Using Epson Bit-Plot Graphics - Your Fantasy Computer System - 8086/88 Function Macros - Auto Disk Format Selection - CP/M Plus Device Tables.
- #85 Volume VIII, Issue 11: A Kernel for the MC68000 - A DML Parser - Towards a More Writable Forth Syntax - Simple Graphics for Printer - 8080 to Z80 Program Conversion, CP/M Plus DPB Macro Fix, and Quicker Submit File Truncation - Floating-Point Benchmarks and an MSDOS COM File Loader - software and book reviews.
- #86 Volume VIII, Issue 12: Faster Circles for Apples - Cursor Control for Dumb Terminals - Dysan's Digital Diagnostic Diskette - Building a Programmable Frequency Synthesizer - Unix and Non-Interactive, User-Unfriendly Software - Interfacing a Hard Disk Within a CP/M Environment - The New MS-DOS EXEC Function.
- #87 Volume IX, Issue 1: NBASIC: A Structured Preprocessor for MBASIC - A Simple Window Package - Forth to PC-DOS Interface - Sorted Diskette Directory Listing for the IBM PC - Emulate WordStar on TOPS-20 - More on optimizing compilers - Problems under CP/M Plus with PAUSE - The PIP mystery device contest - Microsoft BASIC - An improved CLINK utility.
- #88 Volume IX, Issue 2: Telecommunications Issue! Micro to Mainframe Connection - Communications Protocols - Unix to Unix Network Utilities - VPC: A Virtual Personal Computer for Networks - PABX and the Personal Computer - BASIC Language Telecommunications Programming - U.S. Robotics S-100 Card Modem - Sysdrive program, bringing up CP/M Plus - PCDOS Close Function - The Microsoft Assembler - more on C layout standards - book and software reviews.
- #89 Vol. 9, Issue 3: RSA: A Public Key Cryptography System, Part I - Introduction to PL/C: Programming Language for Compilers - Program Design Using Pseudocode - More on Binary Magic Numbers - Basically Precise - Stocking Up - How fast is CP/M Plus? - CP/M 2.2 BIOS Function: SELDSK - The results of the Floating-Point benchmark - book and software reviews.
- #90 Vol. 9, Issue 4: Optimizing Strings in C - Expert Systems and the Weather - RSA: A Public Key Cryptography System, Part II - BASICFMT for TRS-80 - Several items on CP/M Plus - CP/M v2.2 Compatibility - BDOS Function 10: Vastly Improved - More on MS-DOS EXEC Function - MS-DOS Volume Labels - Finding Size of TPA under MS-DOS 2.0 - some comments about Unix - Low-Level Input-Output in C - More on Link Formats and Runtime Libraries - some information on TEX - software reviews.

TO ORDER:

Send \$3.50 per issue (or \$12.50 for every set of 5) to: Dr. Dobb's Journal, P.O. Box E, Menlo Park, CA 94026.

Please send me the issue(s) circled: 66 68 69 70 71

72 73 75 76 77 78 79 80 81

82 83 84 85 86 87 88 89 90

I enclose \$ _____ (U.S. check or money order).

Outside the U.S., add \$.50 per issue.

Please charge my: ☐ Visa ☐ M/C ☐ Amer. Exp.

Card No. _____

Exp. Date _____

Signature _____

Name _____

Address _____

City _____

State _____ Zip _____

Availability on first come/first serve basis. Outside the U.S., add \$.50 per issue ordered. Price includes issue, handling, and shipment by second class or foreign surface mail. Within the U.S., please allow 6-9 weeks to process your order second class. For faster service within the U.S., we'll ship UPS if you add \$1.00 for 1-2 issues and \$.50 for each issue thereafter. We need a street address, not a P.O. Box. Outside the U.S., add \$1.50 per issue requested for airmail shipment.

Solutions to Quirks in dBASE II

At Money Tree Software in Corvallis, Oregon, we offer a service to financial planners called MoneyNet. MoneyNet is a computer data base accessed by a modem from which planners can retrieve timely data about various financial matters.

The entire system is written in dBASE II. We tried several of the dBASE II look-alikes, which claim more records, more fields, and more memory variables, before committing to dBASE II. Let me say, with firsthand experience, that from a high-level language perspective dBASE II is the clear choice of most serious programmers.

However, as good as dBASE II is, it does have some quirks.

The quirk I will address here is the lack of an INKEY function like that found in other high-level languages. The INKEY can be used to interrupt a long listing or print-out without aborting the program entirely.

The Problem

Almost any standard CP/M text file can be converted to a dBASE II data file simply by creating a data base of one field, character type, and length of 80 then appending from the desired text file using the SDF option. Each record of the data base will be one line of text. Displaying the text can be a function of a normal DO-LOOP like this:

```
USE TEXTFILE
DO WHILE .NOT. EOF
? LINE
SKIP
ENDDO
```

But suppose this routine is part of a menu-driven, end-user application and the user decides in the middle of the DO-LOOP that he or she wants to stop reading this text and return to the main menu. How can the user abort the loop from the keyboard? ESCAPE has been turned off, since we don't want the end user at the DOT-PROMPT level, and it wouldn't meet the user's need anyway since he or she wants program flow to continue after exiting the DO-LOOP.

by Gene Head

Gene Head, 2860 NW Skyline Dr., Corvallis, OR 97330.

We need a way to check whether a key has been pressed at the keyboard after each record (one line of text) has been displayed. That way, our DO-LOOP could be aborted with a control-C from the keyboard as shown in Figure 1 (page 99).

The standard answer is to write a CALLable machine language routine to monitor the keyboard, usually by doing a BIOS function call. Unfortunately, this scheme will not work because dBASE II polls the keyboard at least once after a character is sent to the console, gobbling up the keyed-in character before any machine language call can grab it. No matter where in the program we put our call to console I/O check, it is very unlikely that our subroutine will recognize the user's key press before dBASE II intercepts it.

A Workable Solution

A disassembly examination of the dBASE II program shows that console input goes something like Figure 2

(page 99). It looks like the solution could be a simple matter of PEEKing at SAVEIT to see the last key pressed. Unfortunately, dBASE II zeros this byte after it uses the keyed-in data. This routine is called *very often*, and SAVEIT will be zero most of the time, containing the keyed-in character for only a very short period. My modification saves the keyed-in byte to a safe RAM location undisturbed by dBASE II (Figure 3, page 99).

This modification means that SAVEIT continues to perform as expected, but LASTKEY is filled with the keyed-in character and remains unchanged until another key is pressed or it is changed with a POKE command. Now we can monitor this location, much like BASIC allows for the INKEY command. The DO-LOOP will print text until the user inputs a control-C (or any desired character) from the keyboard or the end of file is found (Figure 4, page 99).

Of course, it isn't quite as easy as it sounds because there is no room to do a

Solutions to dBASE II Listing

```
A>DDT DBASE.COM
DDT VERS 2.2
NEXT PC
4E00 0100
-L 3A81
  3A81 MVI E,FF
  3A83 MVI C,06
  3A85 CALL 0005
  3A88 ORA A
  3A89 RZ
  3A8A STA 4378 <---- PATCH JMP HERE
  3A8D RET
  3A8E PUSH B
  3A8F PUSH D
  3A90 PUSH H
  3A91 CALL 3A62
-
-A3A8A
3A8A JMP 14A <---- PATCH JMP HERE
3A8D
-
-A14A
014A STA 4378 <---- INSTRUCTION WE PATCHED OUT
014D STA 151 <---- ADDED INSTRUCTION
0150 RET
0151 DB 0 <---- 337 DECIMAL (LASTKEY)
0152
-
-GO
A>SAVE 77 DBASE.COM
A>
```

End Listing


```

USE TEXTFILE
DO WHILE .NOT. EOF .AND. KEY:PRESS<>3 * 3=CONTROL-3
? LINE
SKIP
ENDDO

```

Figure 1.

```

CONIN  MVI    E,OFFH  ; SET UP FOR DIRECT CONSOLE INPUT
        MVI    C,9
        CALL   BIOS   ; DO DIRECT CONSOLE I/O
        ORA    A
        RZ      ; NOTHING TYPED SO RETURN
        STA    SAVEIT ; SAVE TYPED KEY
        RET

```

Figure 2.

```

CONIN  MVI    E,OFFH  ; SET UP FOR DIRECT CONSOLE INPUT
        MVI    C,9
        CALL   BIOS   ; DO DIRECT CONSOLE I/O
        ORA    A
        RZ
        STA    SAVEIT ; SAVE keyed-in character
        STA    LASTKEY ; ... and to a SAFE location
        RET

```

Figure 3.

```

USE TEXTFILE
DO WHILE .NOT. EOF .AND. PEEK(LASTKEY) <> 3 * 3=CONTROL-C
? LINE
SKIP
ENDDO

```

Figure 4.

```

? 'YOU HAVE FIVE SECONDS TO ANSWER --> '
STORE 100 TO TIMER
POKE 0,337
DO WHILE TIMER .AND. PEEK (337) = 0
STORE TIMER -1 TO TIMER
STORE PEEK (337) TO ANSWERED
ENDDO
IF ANSWERED
? 'YOU ENTERED AN ANSWER IN TIME'
ELSE
? 'YOU FAILED TO ENTER AN ANSWER IN TIME'
ENDIF

```

Figure 5.

direct in-line patch in dBASE II and my modification adds three bytes of code. So we have to do some redirection to an unused RAM area in dBASE II.

The screen I/O, as defined using the INSTALL.COM program, is saved in low memory from about 10D hex to about 152 hex. Because the codes starting at 14A hex are all zeros in my installed dBASE II, this is where I put the patch. As far as I can tell, dBASE II never addresses this RAM. *Your installed dBASE II may use these bytes*, so first look around this area for eight consecutive bytes of zeros and then put your patch there.

This is what will happen. Instead of storing the keyed-in character at SAVEIT using the STA SAVEIT instruction, we use these three bytes to do a jump to our unused area of RAM in the screen data table. Here we do the first store just like the store we patched over: STA SAVEIT. In addition, we save the keyed-in data to a safe RAM location with STA LASTKEY. Finally, we return. Our patch is done and dBASE II will not even know it is there!

If you use dBASE II 2.4, the DDT session in the Listing (page 98) will permanently modify your dBASE II to recognize a keyed-in character by PEEK (337). Now a PEEK (337) will always show the last key pressed. This can be used to time-out input, as shown in Figure 5 (below).

The DO-LOOP application has already been explained, and I hope you can come up with unusual applications I haven't thought of.

Next time I will present a short piece on verifying zip codes in mailing lists.

■ ■ ■

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 197.

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)

DYNAMIC RAM		
256K	200 ns	\$59.90
64K	200 ns	5.87
64K	150 ns	5.99
64K	120 ns	7.50
16K	200 ns	1.15
EPROM		
27128	300 ns	\$22.50
2764	250 ns	9.25
2732	450 ns	8.50
2716	450 ns	3.60
2532	450 ns	4.75
STATIC RAM		
6264P-15	150 ns	\$42.00
6264LP-15	150 ns	44.00
6116P-3	150 ns	6.56

MasterCard VISA or UPS CASH COD

Factory New, Prime Parts

MICROPROCESSORS UNLIMITED

24,000 South Peoria Ave. (918) 267-4961

BEGGS, OK 74421

Prices shown above are for March 15, 1984

Please call for current & volume prices. Prices subject to change. Please expect higher prices on some parts due to world wide shortages. Shipping and insurance extra. Cash discount prices shown. Small orders received by 6 PM CST can usually be delivered to you by the next morning, via Federal Express Standard Air -- \$5.99!

Circle no. 41 on reader service card.

by Michael Wiesenberg

But Does It Have "Of Interest"?

Want to find all articles about your IMSAI, Sorcerer, or HP 87? The **Microindex**, from Serious Personal Computing, is various flavors of periodicals that index the multiplicity of articles in over 70 computer magazines, a sort of Readers' Guide to Periodical Literature of computer publications. *Microindex*, a monthly for libraries, universities, and large businesses, cross-references the entire spectrum of computer magazines, and costs \$99 a year or \$12 an issue. The monthly *Abridged Microindex*, for smaller organizations, indexes a subset of 32, at \$49 per year or \$6 per issue. Yes, *DDJ* is in it. Annual *Microindexes* specific to various magazines cost \$5 to \$12 each. I know that you will all want to order the *Microindex* to *Dr. Dobb's Journal*, Volume 8, for \$7. Also available are complete one-volume monthlies and annuals on various topics, as education, business, Apple, IBM, Commodore, and so on. **Reader Service No. 111.**

C You on 8086

Version 2 of **Lattice C** is now available for 8086 and 8088 for most MS-DOS computers. Programs can address 1Mb of memory, and be as long as 1Mb. The new library handles multilevel file directories and is compatible with recent versions of Unix. Compiler costs \$500, and library source is also \$500. You can get an update from whoever supplied your original. **Reader Service No. 109.**

Million Dollar Computer Poker Challenge

Can a computer play intelligent poker? You wouldn't think so to judge from the poker games available on today's micros, but **Mike Caro** ("The Mad Genius of Poker"), renowned poker writer and games programmer, is so convinced his Apple can beat any human that he has issued a \$100,000 challenge to several world-class poker players, and been accepted by two

former champions of **The World Series of Poker**. A Vegas casino owner has offered a counterchallenge: to play for *one million dollars cash*. To ensure that the computer is not "helped" in its decisions by the operator, special decks of cards with optical codes on the faces and optical scanners will be provided by the **Data Bar Corporation**. Think you can play poker better than a computer? You might get a chance to try if you've got a million dollars to back you up. Better yet, can you program your computer to beat Caro's? Win or lose, the publicity for your game would be worth well over a million dollars.

Caro also plans on releasing the challenge soon as a home game, with the slogan, "Play the program that won a million dollars in the World Series of Poker." I've seen an advance copy, and the card graphics are impressive, much better than those tiny attempts at exact representation that are impossible to read that I've seen in other commercial games. **Reader Service No. 101.**

But What if Your Printing Isn't Legible?

For those who get tired of using keyboards, Pencept's **Penpad** lets you input data by handwriting. I mean hand *printing*, and you'll have to learn to represent lowercase letters with half-height capitals, and you have to stay within the lines just like you did in first grade. The real value in this product seems to be in designing custom forms, in conjunction with the **Penpatch** utility.

Penpad is directly compatible with VisiCalc, MultiPlan, Lotus 1-2-3, and WordStar. For \$995 on the PC, you get tablet, ballpoint with side-mounted activation button, and a board for the PC. The board has its own MC68K CPU that has the character recognition software, sending input that looks to the computer like it came from the keyboard. Penpad is also what they call "the mouse that writes," because stylus motion and button pressing can be translated into cursor commands. **Reader Service No. 115.**



Save A Sorcerer

Now that Exidy no longer makes them, how do you thousands of Sorcerer owners get service and answers to your questions? Contact **Jack MacGrath**, who provides technical support, has parts, services Micropolis drives, and buys and sells systems. **Reader Service No. 103.**

Less for 40

You may recall my predicting a year ago that prices would come down considerably on hard disks with increased storage. CompuPro's **H40 Hard Disk Subsystem** for its IEEE 696/S-100 bus compatible microcomputers costs \$5495, and comes with a 40Mb Quantum 5.25-inch hard disk, CompuPro's Disk 3 DMA disk controller, CP/M-80 or -86, and a double-density Qume Trak 842 floppy disk drive with 2.8Mb for backup on single- or double-density, single- or double-sided media.

And, while they've got our attention, CompuPro would like us to know that they have the first commercially available IEEE 696-compatible, 80286-based, multiuser microcomputer. This is, of course, Intel's new CPU that is upward compatible from the 8088 and 8086, but runs at 6 MHz, or twice as fast as 8086- or 68K-based systems. The **System 816/F** also has an 80287 math coprocessor. It comes with 512K 16-bit static memory, expandable to 1Mb, 12 serial ports, one Centronics-compatible printer port, one parallel port, 1.2Mb floppy storage, a 40Mb hard disk, and CP/M-86 and MP/M-86. \$14,995 walks away with it. **Reader Service No. 119.**

Or Pascal

Limbic Systems has a **Pascal Compiler** for the Commodore 64 that generates native code. The package comes with linker, debugging facilities, and editor, and costs a phenomenal \$50. **Reader Service No. 107.**

Zenith Pretends It's PC

Z-Util from Lindley Systems is IBM PC emulation for the Zenith Z-100, emulating keyboard input,

screen printing and scrolling, and printer output, so that WordStar, the Perfect series, and dBaseII all run. Only modem and graphics programs don't run, because of the differences in hardware. Screen dumps, however, do work, with automatic logic-seeking and correct screen aspect ratios. All this for \$35. **Reader Service No. 121.**

New Character for Old Printwheels

How often have you wished for an odd symbol on your printer: an at-sign, or copyright symbol, for instance, or maybe that elusive TM that actually exists on some printwheels? **Business Support Services** will replace any character on your Diablo, Xerox, or Qume metal or plastic printwheel with any other available character. **Reader Service No. 117.**

64-4th or Fight

C64 UNIFORTH, from Unified Software Systems for the Commodore 64, is they claim, "virtually identical to our other FORTH systems, making application software particularly easy to port." The emphasis is mine, and the reason it's there is because *virtually* is one of those all-inclusive advertising words that means whatever the person using it wants it to. As Humpty Dumpty said, "When I make a word do a lot of work like that, I always pay it extra." That is, as Sportin' Life sang, "It ain't necessarily so." I'm not saying their claim isn't valid, just that *virtually* is one of those words that doesn't like to be pinned down. (Neither does *compatible*.) Anyway, high-level source files use what they call the 1541 "relative file" access, with words included to create, delete, switch and load from these files. You can set and read directly from UNIFORTH the system clock time and date, access the graphics controller chip, including analog-to-digital conversion, and control the light pen, joystick, and three sound voices. You get a complete 6502 assembler, with easy data stack accessing macros, and a video editor with cursor addressing. The integer version, \$70, is available now, while the software floating-point version, \$125, is coming soon. You can upgrade for the difference in price. Full kernel sources cost \$90. Write for a free brochure. **Reader Service No. 105.**

Catch Your Words

You can get an inexpensive print-out basket on which your printer sits from **Systems Enhancement Engineering**. \$22.50 for the 12-inch model and \$24.50 for 18, plus \$3 p. and h. **Reader Service No. 113.**

Not Another Cute Head!

Tweaker, from Kludge Enterprises, is a hardware/software product for programmers and hardware engineers that puts that extra little bit into products always needed to ship them out the door. Specify format. \$595 FOB VARPTR LAX. **Reader Service No. 0.**

Contact Points

Business Support Services, Inc., 705 Butternut Ave., Royal Oak, MI 48073; (313) 585-4736.

Caro's Poker Challenge: contact Henri Bollinger Agency, 9200 West Sunset Boulevard, Los Angeles, CA 90038; (213) 274-8483.

CompuPro, 3506 Breakwater Court, Hayward, CA 94545; (415) 786-0909.

Data Bar Corporation, 10202 Crosstown Circle, Eden Prairie, MN 55344; (800) 672-2776.

Lattice, Inc., Box 3072, Glen Ellyn, IL 60138; (312) 858-7950.

Limbic Systems, 560 San Antonio Road, Suite 202, Palo Alto, CA 94306; (415) 424-0168.

Lindley Systems, 21 Hancock Street, Bedford, MA 01730; (617) 275-6821 (evenings and weekends).

Jack MacGrath, 73 Jordan Road, North Chelmsford, MA 01863; (617) 251-4776.

Pencept, Inc., 39 Green St., Waltham, MA 02154; (617) 893-6390.

Serious Personal Computing, Box 7059, South Nashua, NH 03060; (603) 888-1376.

Systems Enhancement Engineering, Box 40215, Indianapolis, IN 46240; (317) 844-8817.

Unified Software Systems, Box 2644, New Carrollton, MD 20784; (301) 552-9590.

■ ■ ■

Reader Ballot

Vote for your favorite feature/article.
Circle Reader Service No. 198.

ADVERTISER INDEX

Reader Service No.	Advertiser	Page No.	Reader Service No.	Advertiser	Page No.	Reader Service No.	Advertiser	Page No.
1	Ashton-Tate	2	28	GTEK	79	57	Quest Research	72
2	Avocet Systems, Inc.	11	29	Hallock Systems Consultants	31	58	Quic-N-Easi Products, Inc.	13
3	BD Software	72	30	Harvard Softworks	80	59	Rational Systems	91
4	BG Micro	75	31	Institute For Applied Forth	69	*	Edward Ream	51
5	Bonnie Blue Software	19	32	Integral Quality	66	60	The Redding Group	74
6	Borland International	104	33	Laboratory Microsystems	3	61	Revasco	91
7	California Digital Engineering	79	34	Lattice, Inc.	59	62	S.C. Digital	69
8	C/Craft	68	35	Lifeboat Associates	15	63	SemiDisk Systems	45
9	The Code Works	57	36	Lifeline	4	64	Shaw Laboratories	70
10	Compu-Draw	71	37	Logical Systems	63	65	Simpliway	69
11	Computer Design Labs	33	38	Manx Software	7	66	Software Architects	102
12	Computer Friends	43	39	MicroMethod	59	67	Software Building Blocks	7
13	Computer Innovations	29	40	MicroMotion	55	68	Software Engineering Consultants	85
14	The Computer Journal	69	41	Microprocessors Unlimited	99	69	Software Toolworks	89
15	Computer Language	14	42	MU Software	87	70	SLR Systems	87
16	Computer Resources of Waimea	71	43	Mylstar Electronics, Inc.	25	71	Solution Technology, Inc.	39
17	Coriolis Company	69	44	Next Generation Systems	30	72	Solution Technology, Inc.	41
18	Creative Solutions	53	45	Novum Organum	87	73	Systems Guilds, Inc.	69
19	C User's Group	61	46	Occo, Inc.	17	74	Telecon Systems, Inc.	102
20	C Ware	64	47	Overbeek Enterprises	81	76	Unified Software Systems	89
83	DDJ Back Issues	97	48	Pacifica Technology	49	77	Visual Age	93
84	DDJ Bound Volume	77	49	Pascal & Associates	21	*	Frank N. Vitaljic	69
21	Data Access Corporation	103	50	Peopeware Systems	63	79	Warner Books	73
22	Datalight	95	51	Phlexible Data Systems	39	80	Widener Consulting	93
23	Dedicated Microsystems	81	52	The Programmer's Shop	67	81	Mark Williams & Company	47
24	D & W Digital	35	53	PRO Micro Systems	57	82	Workman & Associates	95
25	Ecosoft, Inc.	48	54	PRO Microsystems	69	85	DDJ Change of Address	79
26	Foehn Consulting	61	55	Protools	69			
27	GGM Systems Inc.	85	56	Puterparts	63			

FourByteForth

32 bits

Address your entire space!
Forth for the Sage Computer

includes:

- a full screen editor
- a full screen debugger
- a high level decompiler
- a complete assembler for the 68000
- debug mode and traps
- 100 page user manual
- fast Byte Sieve 1.8 seconds
compiles 125* screens/minute

Special introductory price: \$250.

Order now from Software Architects

1912 Grant, Berkeley, CA 94703

(415) 549-3185

Specify terminal with order.

*approximate

C COMPILER

- FULL C
 - UNIX* Ver. 7 COMPATABILITY
 - NO ROYALTIES ON GENERATED CODE
 - GENERATED CODE IS REENTRANT
 - C AND ASSEMBLY SOURCE MAY BE INTERMIXED
 - UPGRADES & SUPPORT FOR 1 YEAR
- C SOURCE AVAILABLE FOR \$2500⁰⁰

HOST	6809 TARGET	PDP-11*/LSI-11* TARGET	8080/(Z80) TARGET	8088/8086 TARGET
FLEX*/UNIFLEX* OS-9*	\$200.00 <small>WITHOUT TARGET</small> \$350.00 <small>WITH TARGET</small>	500.00	500.00	500.00
RT-11*/RSX-11* PDP-11*	500.00	200.00 <small>WITHOUT TARGET</small> 350.00 <small>WITH TARGET</small>	500.00	500.00
CP/M* 8080/(Z80)	500.00	500.00	200.00 <small>WITHOUT TARGET</small> 350.00 <small>WITH TARGET</small>	500.00
PCDOS*/CP/M86* 8088/8086	500.00	500.00	500.00	200.00 <small>WITHOUT TARGET</small> 350.00 <small>WITH TARGET</small>

*PCDOS is a trademark of IBM Corp. MSDOS is a trademark of MICROSOFT. UNIX is a trademark of BELL LABS. RT-11/RSX-11/PDP-11 is a trademark of digital Equipment Corporation. FLEX/UNIFLEX is a trademark of Technical Systems consultants. CP/M and CP/M86 are trademarks of Digital Research. OS-9 is a trademark of Microware & Motorola.

408-275-1659

TELECON SYSTEMS

1155 Meridian Avenue, Suite 218
San Jose, California 95125

Circle no. 66 on reader service card.

Circle no. 74 on reader service card.



INFINITE SOLUTIONS

Like the molecules in a snowflake, the elements of a computer database can be structured and related in an infinite variety of combinations. Being able to present these combinations quickly and efficiently, with maximum flexibility and minimum programming knowledge, is the mark of excellence which sets the sophisticated database management system apart from the ordinary.

Thousands of satisfied users, from amateur and professional programmers to government agencies, major corporations and industries, have found that DataFlex has no equal in applications development software.

Write or phone for our latest literature and a list of existing applications.

Compatible with CP/M,
CP/M-86, MP/M-86,
MSDOS, PC DOS, TurboDOS,
Novell Sharenet, PC-Net,
Molecular N-Star, Televideo
MmmOST, Action DPC/OS,
Omninet, IBM PC w/Corvus
and OSM Muse.

DATA FLEXTM
APPLICATIONS DEVELOPMENT SOFTWARE

DATA ACCESS CORPORATION

8525 S.W. 129th Terrace, Miami, Florida 33156 (305) 238-0012 TELEX 469021 Data Access CI

MSDOS is a trademark of Microsoft. CP/M and MP/M are trademarks of Digital Research. DataFlex is a trademark of Data Access Corp.

Circle no. 21 on reader service card.

ANNOUNCING . . . VERSION 2.0



"What I think the computer industry is headed for: well documented, standard, plenty of good features, and a reasonable price."

Jerry Pournelle,
Byte, February 1984

"The Perfect Pascal"

Alan R. Miller,
Interface Age, January 1984

If you already own Turbo Pascal version 1.0, you can upgrade to 2.0 for \$29.95. Just send in your old master with your check. (Manual update included of course).

EXTENDED PASCAL FOR YOUR
IBM PC, PC jr., APPLE CP/M,
MSDOS, CP/M 86, CCP/M,
OR CP/M 80

NOW . . . WITH WINDOWING \$49.95

NEW FEATURES

WINDOWING!

... This is a real shocker. On the IBM PC or PC jr. you'll now have a procedure to program windows. . . . Any part of the screen can be selected as a window and all output will automatically go to this part of the screen only. As many windows as you please can be used from the same program.

AUTOMATIC OVERLAYS!

... No addresses or memory space to calculate, you simply specify OVERLAY and TURBO PASCAL will do the rest.

GRAPHICS, SOUND AND COLOR SUPPORT

... For your IBM PC or JR!

FULL HEAP MANAGEMENT!

... via dispose procedure.

OPTIONAL 8087 SUPPORT!

... Available for an additional charge.
If you have a 16 bit computer with the 8087 math chip—your number crunching programs will execute up to 10X faster!

ORDER YOUR COPY OF TURBO PASCAL VERSION 2.0 TODAY

For VISA and MasterCard orders call toll free:

1-800-227-2400 x968

In CA:

1-800-772-2666 x968

(lines open 24 hrs, 7 days a week)
Dealer & Distributor Inquiries welcome
408-438-8400

CHOOSE ONE (please add \$5.00 for shipping and handling for U.S. orders)

- ☐ Turbo Pascal 2.0 \$49.95
- ☐ Turbo Pascal 2.0 with 8087 support \$89.95
- ☐ Update (1.0 to 2.0) Must be accompanied by the original master \$29.95
- ☐ Update (1.0 to 8087) Must be accompanied by the original master \$69.95

Check ☐ Money Order ☐
VISA ☐ MasterCard ☐
Card #: _____
Exp. date: _____ Shipped UPS

BORLAND
INTERNATIONAL

Borland International
4113 Scotts Valley Drive
Scotts Valley, California 95066
TELEX: 172373

My system is: 8 bit _____ 16 bit _____
Operating System: CP/M 80 _____
CP/M 86 _____ MSDOS _____ PC DOS _____
Computer: _____ Disk Format: _____
Please be sure model number & format are correct.

NAME: _____
ADDRESS: _____
CITY/STATE/ZIP: _____
TELEPHONE: _____

California residents add 6% sales tax. Outside U.S.A. add \$15.00. (If outside of U.S.A. payment must be by bank draft payable in the U.S. and in U.S. dollars.) Sorry, no C.O.D. or Purchase Orders. A11